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GROUND CONTROLLED APPROACH CONTROLLER TRAINING SYSTEM (GCA-CTS)--ETC(U)
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This training manual covers the basic concepts involved in Ground Controlled Approach (GCA) air traffic control procedures. It is intended for use in conjunction with the computer managed instruction provided by the Ground Controlled Approach Controller Training System (GCA-CTS).

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LEVEL ONE

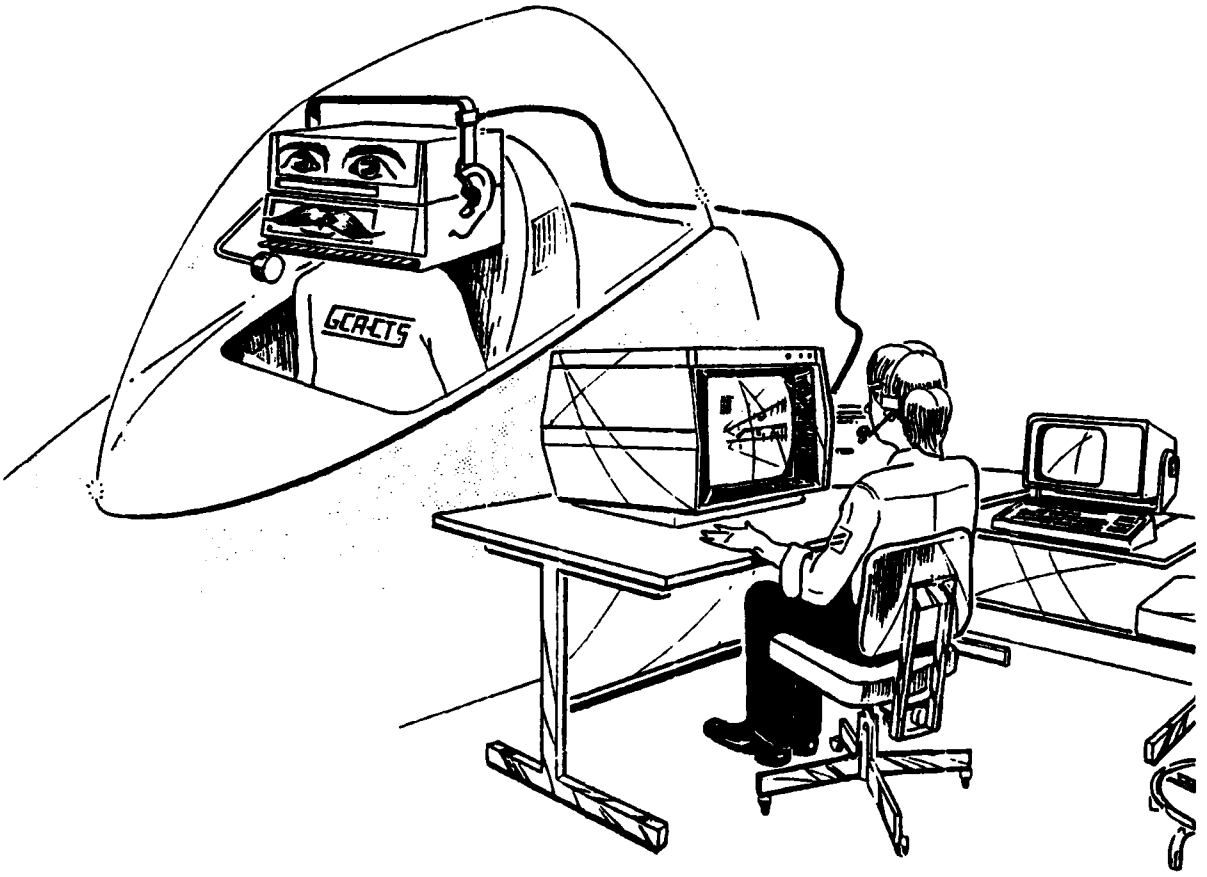
THE
GROUND CONTROLLED APPROACH CONTROLLER TRAINING SYSTEM
(GCA-CTS)

1.0 INTRODUCTION

You have been chosen to participate in a new learning experience using

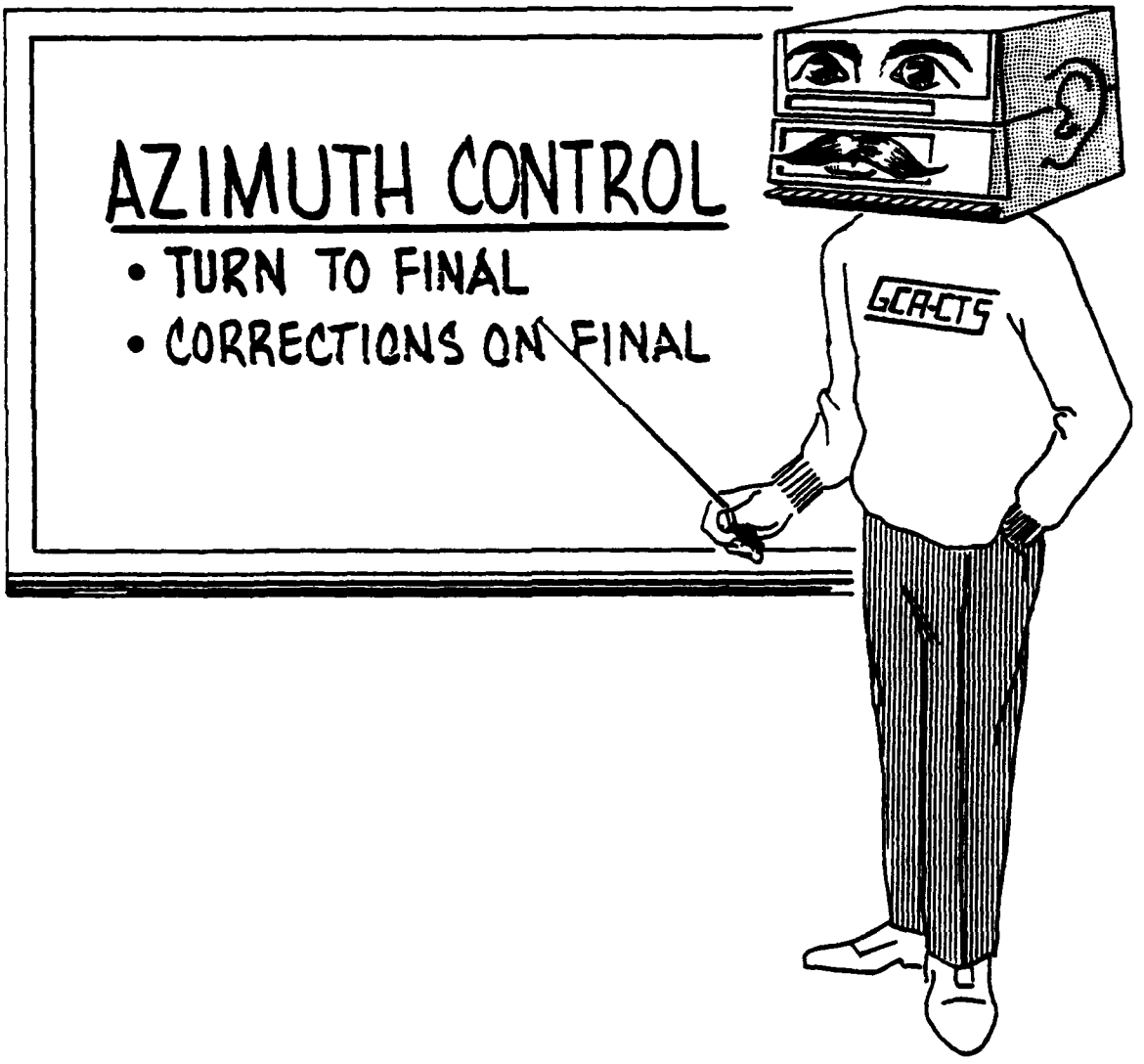
GCA-CTS

Most of your fellow students will learn GCA control procedures in much the same way that you learned ASR procedures: by talking to a pseudo pilot who flies the bug. You will use a system in which a computer will take over the pseudo-pilot duties.

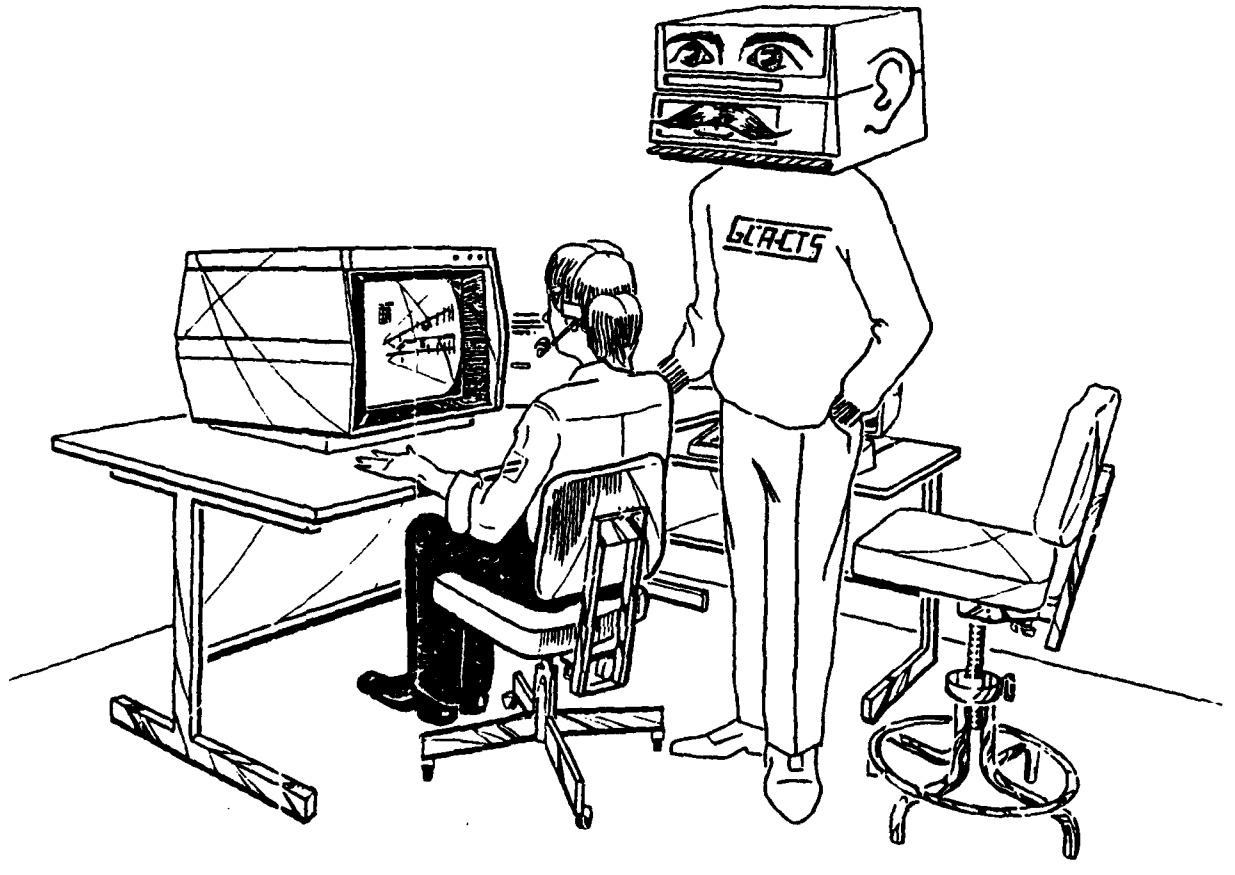


It may sound strange, but the GCA-CTS will actually listen to what you say and fly the bug itself. It will even talk back to you!

There are many advantages to using the GCA-CTS. First, you will never have to take turns being a pseudo pilot. Secondly, the GCA-CTS does a lot more than just fly the bug. It will teach you to perform your duties as a GCA controller.



It will devote its full attention to you, and give you objective feedback about your performance on every approach you conduct.



You can even ask for a replay of the approaches you conduct and see and hear how you did.

1.1 ELEMENTS OF GCA-CTS

There are many elements in the GCA-CTS. This section briefly describes some of them. GCA-CTS has an automated instructor who selects problems for you and who gives feedback about your performance like this:

You have completed 4 of the 10 runs necessary to pass task: T03$03.03
Your performance on the new material:

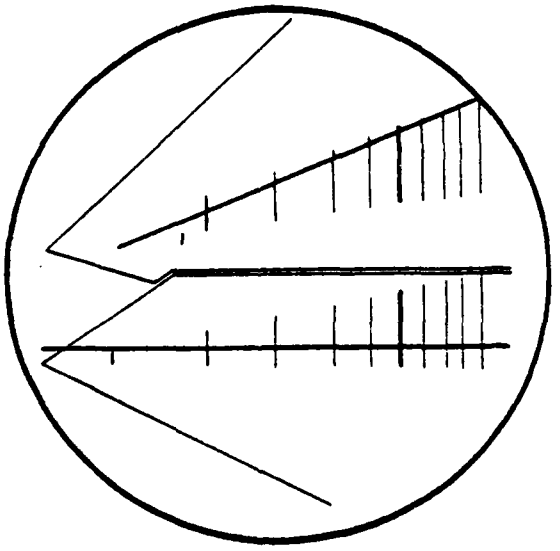
Range calls	Perfect

Your performance on other tasks:

Course position	Needs work
Course corrections	Satisfactory

There is an aircraft/pilot/environment simulation (APE) which flies the aircraft according to your instructions and talks to you. In fact, there are five pilots who fly for GCA-CTS. Their skills vary – one is very good, one is terrible, and the other three fall in between. In this way GCA-CTS can give you experience in handling all sorts of control situations.

There is a simulated radar system which gives you an accurate PAR display.

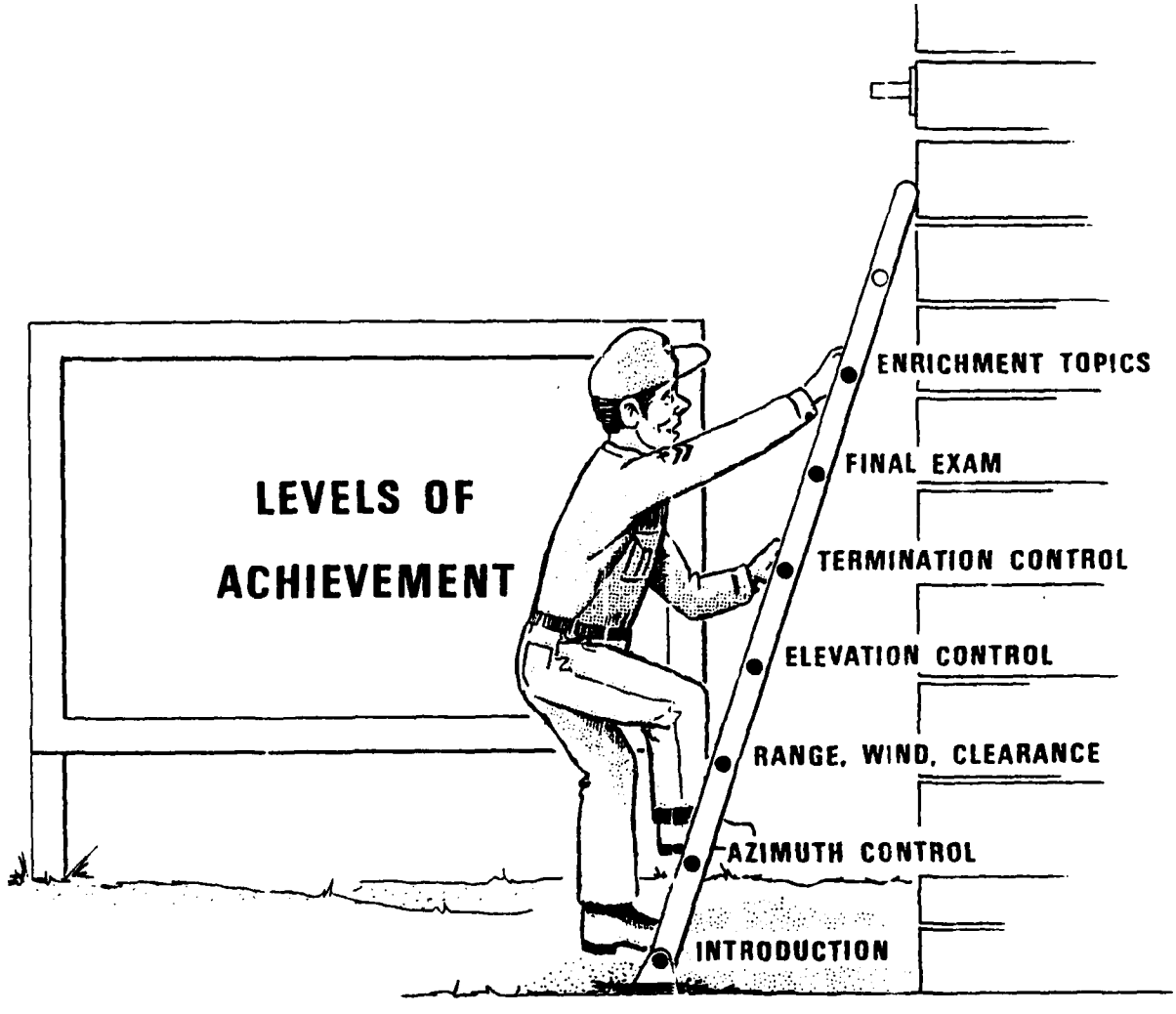


There is a simulated GCA controller who will demonstrate procedures. It will also conduct approaches when you are not using the system.

Finally, there are various librarians who save all sorts of data about your performance for use by you and your learning supervisor. One even saves data so you can see and hear a replay of any practice problem.

1.2 GCA-CTS SYLLABUS

Like any good teacher, the GCA-CTS has a syllabus which it will use to select instructional materials for you. The syllabus is organized into levels of achievement.



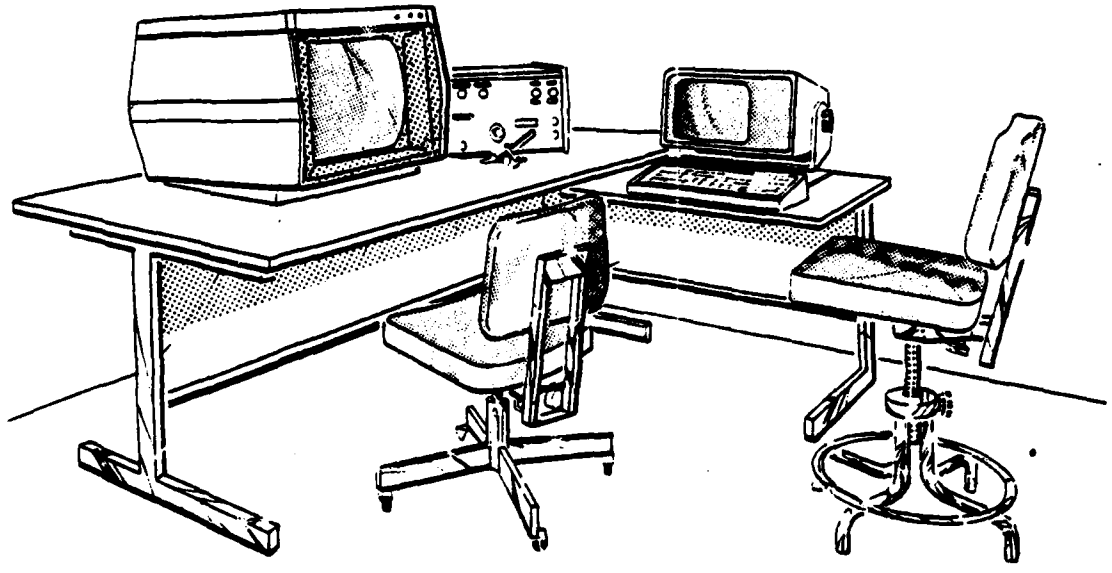
Within each level of achievement, GCA-CTS will give you a variety of learning experiences. These are the modes of operation you will see:

- INSTRUCTIONAL MODE: GCA-CTS will teach you new skills.
- FREEZE AND FEEDBACK MODE: You will practice the new skills and GCA-CTS will freeze and explain any errors you may make. Before it gives you a freeze and feedback problem, GCA-CTS will ask if you want to skip this mode of instruction. You can go on to regular practice if you feel you understand the material well enough.
- PRACTICE MODE: You will practice your new skills and receive feedback after the approach.
- REPLAY MODE: You may request that the system replay a practice approach so you can see and hear what you did. During this replay you can also request that the system explain the errors it detected.
- P-RUN MODE: GCA-CTS will give you a performance test when you complete the syllabus.

Your progress through the syllabus depends on your performance. You are required to complete a minimum number of problems. After that, you will advance to the next task when you have demonstrated that you understand the material.

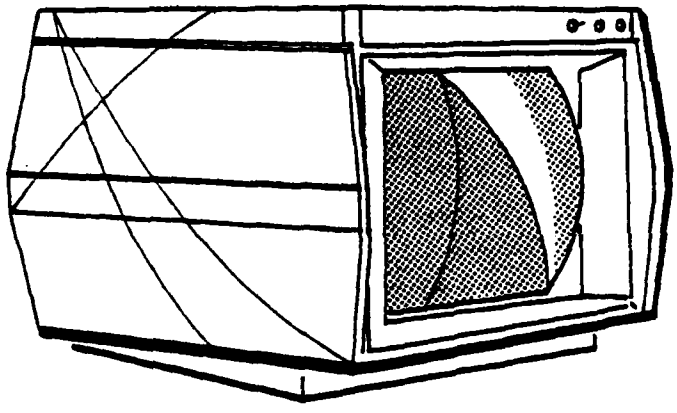
1.3 USING THE GCA-CTS

The trainee station which you will use looks like this:



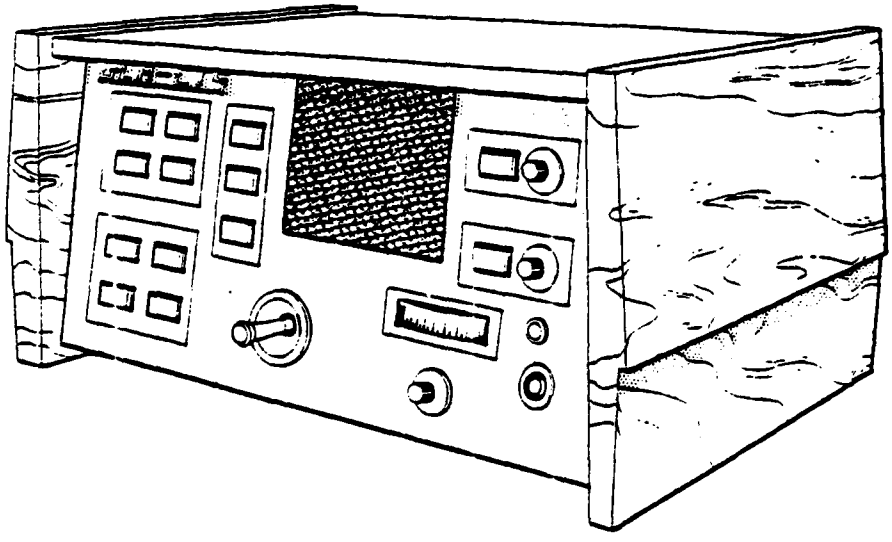
The various elements are described in the following pages.

THE SIMULATED RADAR INDICATOR. This display unit will take the place of the operational PAR indicator.



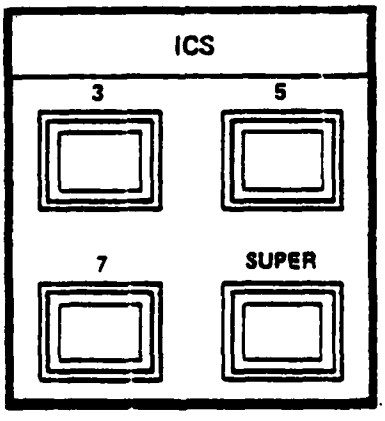
GCA-CTS uses a simulator rather than an operational radar to enhance training effectiveness. As you are aware, the PAR display is quite complex. The sweep can also be distracting at first. Using this simulator, GCA-CTS can emphasize the relevant parts of the display in a way that would be impossible with the operational gear.

THE COMMUNICATIONS PANEL. Your communications equipment is centralized in a unit mounted to the right of the simulated radar display. You will also have a footkey for your radio transmitter.

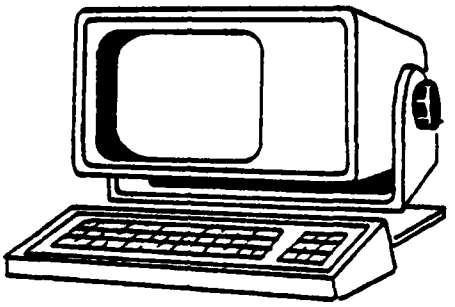


You are already familiar with the operation of the ICS and radio frequency selection buttons used at the school, and you will find that the GCA-CTS communications gear works in the same way as that with which you are familiar.

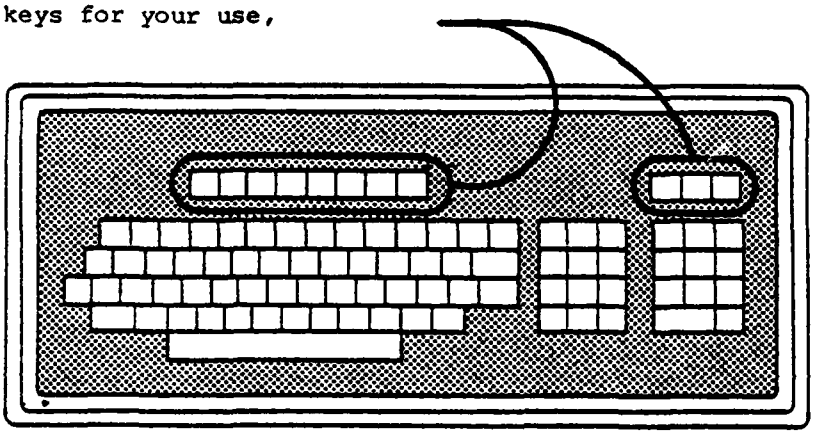
On this panel, the ICS buttons marked 3, 5, and 7 are for other controllers within the GCA-CTS system. They do not connect to controller positions at the school. The SUPER button does connect with the learning supervisor station, however. This station is in the instructor workroom. Your learning supervisor can monitor your performance from this station and can talk with you over the ICS.



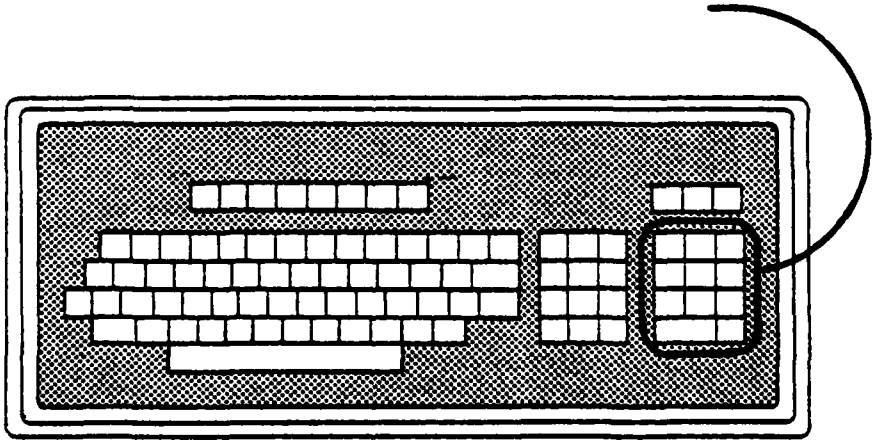
THE KEYBOARD AND CRT. You will use this device to communicate with the CGA-CTS.



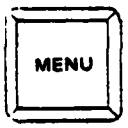
It has some keys for your use,



and also some which only your learning supervisor can use.



These are the special keys for your use and explanation of what they do:



Types a list of keys which you may press. (If you press other keys, the system just says "ILLEGAL ENTRY.")

Posts a message at the learning supervisor station saying that you have requested assistance.

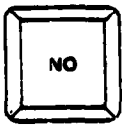
Starts voice testing at the end of the current problem (see 1.5).

Stops voice testing.

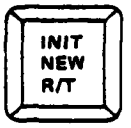
Used to sign on. When you take your post, strike this key. GCA-CTS will ask for your last name. Type it in, and you're ready to go.

This tells GCA-CTS that you want to take a break. It will sign you off at the end of the current problem. Don't leave your post without signing off!

Aligns your radar display.



GCA-CTS will ask you questions and ask you to respond using these keys.



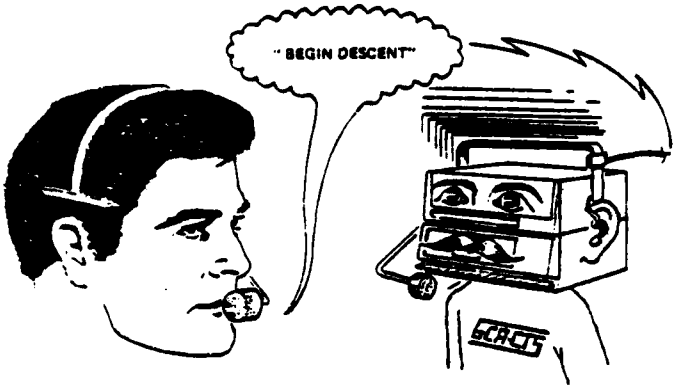
There is one key which both you and your instructor may use. It is marked INIT NEW R/T, and it enables you to record new speech patterns if necessary. If you should ever need it, Appendix A describes the use of this key. Before reading about it though, let's discuss the speech recognition system.

1.4 SPEECH RECOGNITION IN GCA-CTS

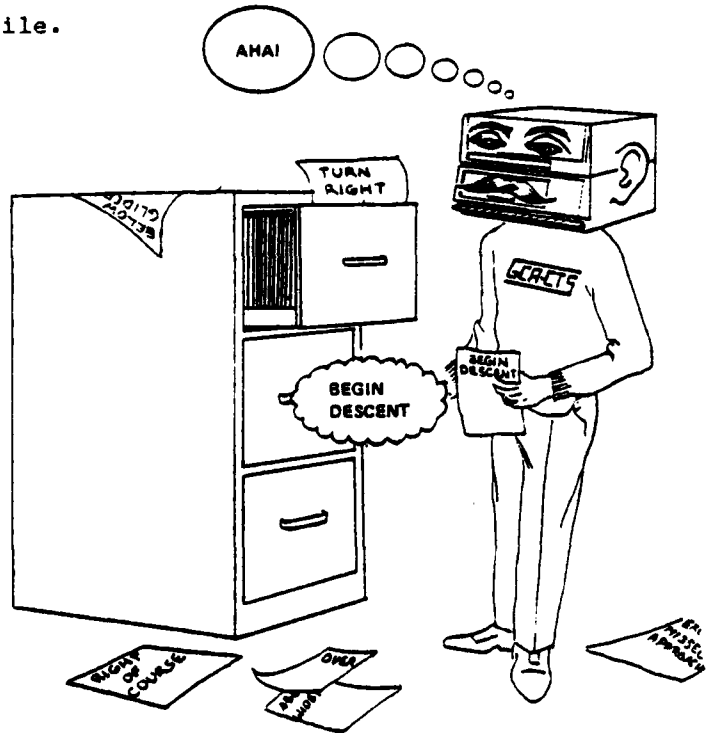
The most unusual feature of GCA-CTS is that it recognizes human speech. In fact, it sounds almost like something out of "Star Wars," doesn't it? In reality, it is extremely difficult to build machines which recognize speech. There are some limitations that humans must put up with when talking to machines. If you understand the machine's limitations, you will find it is easy to learn to speak so it can understand you. To use GCA-CTS effectively, you will have to:

- Use precise terminology
- Teach the machine to recognize your voice
- Pause between phrases
- Speak naturally
- Be careful to position the microphone properly.

These rules aren't hard to learn. As you know, the use of precise terminology is of utmost importance in air traffic control. It is also important to enable the GCA-CTS pilot to understand your transmissions. You see, the computer listens while you are speaking.



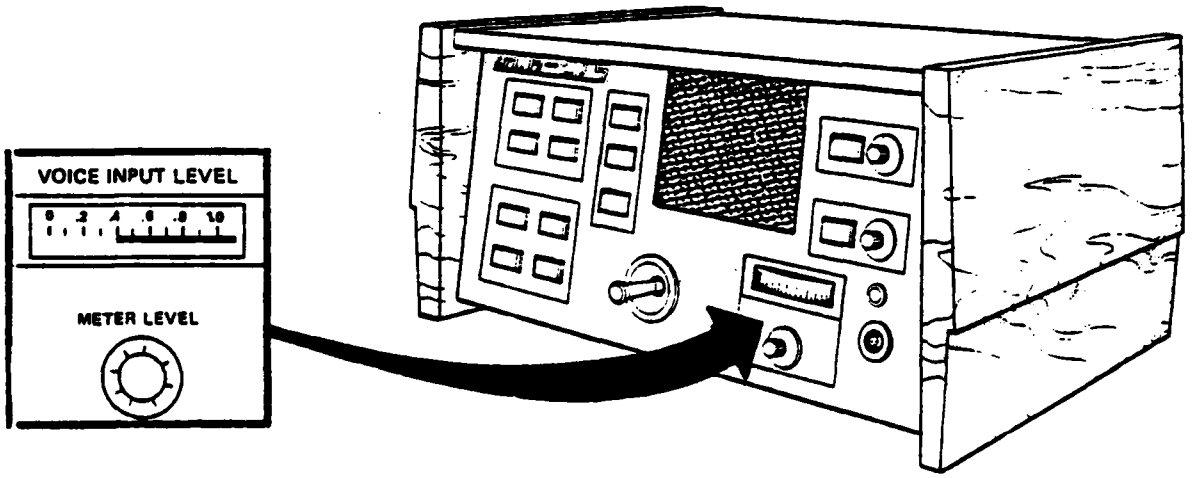
Then it compares what it heard with all the patterns of your voice that it has on file.



If you use terminology that it does not have on file, it will not be able to understand you.

The GCA-CTS will collect samples of the way you say each phrase while you are learning to use that phrase. Then when you go on to practice your new skill, it will have the patterns it needs to recognize your voice. To ensure success:

- Position your microphone so that your lips almost touch the foam casing when you pucker up.
- Adjust the voice input meter level knob until the meter reads green when you speak into the microphone in a natural voice, saying the word "five."



- Once you find a good voice level for you, always set the meter to that level when you sign on.
- Be careful to pause between phrases. In this guide the required phrases are indicated like this:

  turn right heading (pause)
  one (pause)
  two (pause)
  three (pause)

  and sometimes like this: "turn right heading...one...two...three." These pauses don't have to be very long (only about 1/4 second). With practice, you will find this is not difficult to do.
- Speak naturally.

IMPORTANT NOTE: The GCA-CTS does not listen in on any of your conversations with your learning supervisor over the ICS. If the SUPER button is depressed (glowing amber), no speech recognition is possible.

1.5 USE OF INIT VOICE TEST

The best way to become proficient in the use of the speech recognition capability is to practice. At any time you may press the key marked INIT VOICE TEST (initiate voice test). At the end of the current problem, the GCA-CTS will say:

SAY ANY PHRASE THAT YOU HAVE LEARNED.
WATCH ME RECOGNIZE YOUR VOICE!

Speak any phrase you have trained it to recognize. With a little practice on your part, it will never miss! Try shortening the pauses between advisories to learn exactly what the system can and cannot do. It is also a good idea to "warm up" with a voice test at the beginning of each day.

To go on to other tasks, depress STOP VOICE TEST.

1.6 GETTING STARTED

Are you ready to start learning your GCA skills? Good! Have a seat at the trainee station. You will see that the system is conducting an approach. Depress the HELLO key and enter your last name when the system asks for it. Training will begin as soon as the demonstration approach is complete.

WELCOME
TO
GCA-CTS!

LEVEL TWO

AZIMUTH CONTROL PROCEDURES

2.0 INTRODUCTION

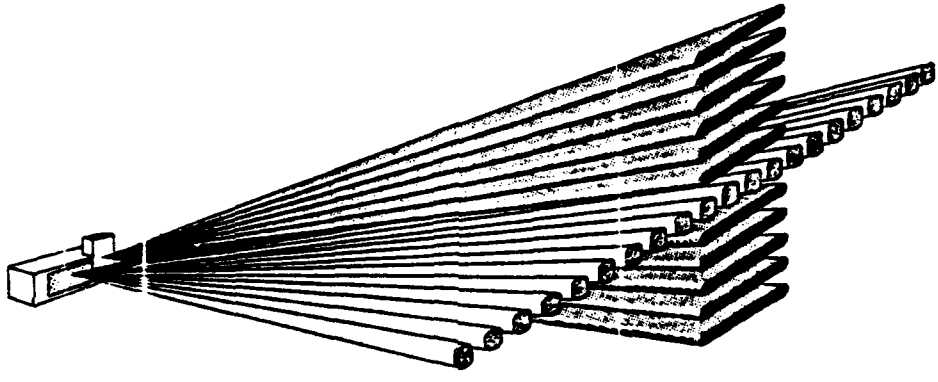
Now that you have had some introduction to the GCA-CTS, you can begin learning about PAR control procedures. By now you should have completed the programmed instruction books and so are ready to study PAR control in greater depth. In this level we will focus on azimuth control procedures. You will learn:

- To ensure the azimuth radar is properly aligned
- To accept the handoff from the pattern controller
- To establish radio contact with the pilot
- To give vectors so the pilot can conduct a smooth turn to final
- To give azimuth corrections on final.

2.1 REVIEW OF AZIMUTH RADAR CONCEPTS

In order to really understand servoing and azimuth radar alignment checking, you must have a good understanding of how the radar works.

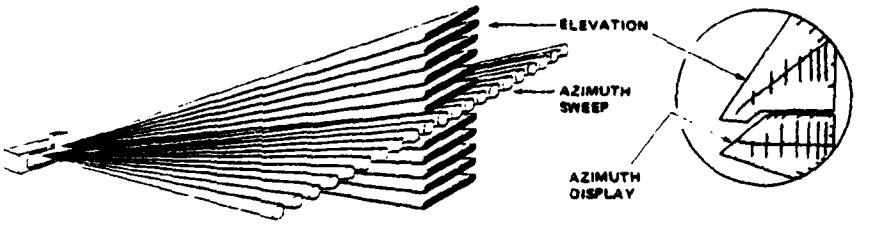
As you learned from your programmed texts, two separate radar displays are presented on the PAR indicator. If the pilot could see the radar scans, they would look something like this:



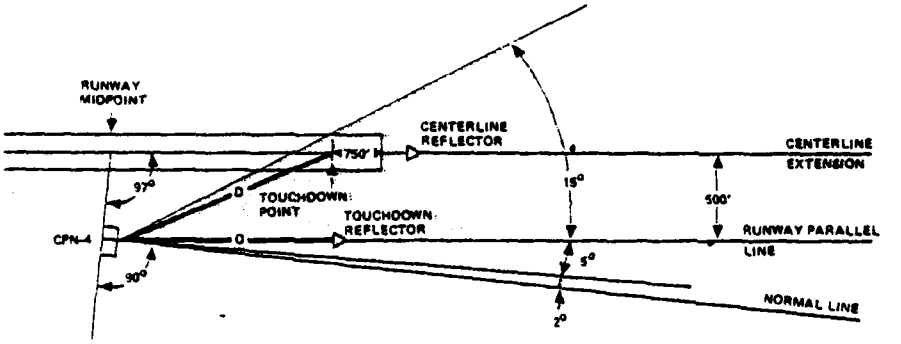
BEFORE TURNING THE PAGE

In the picture above, which is the azimuth sweep? Picture in your mind the way this information looks on the PAR indicator. Where is azimuth information shown?

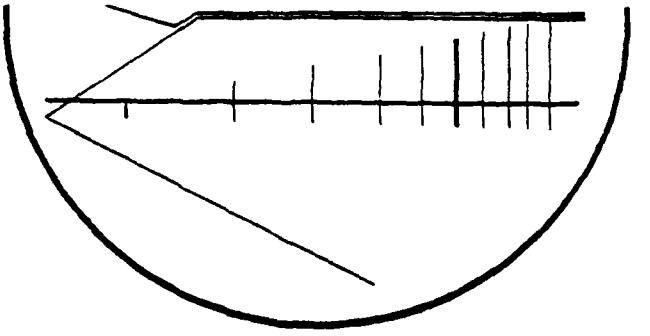
Check the accuracy of your recall against this drawing.



A top view of the azimuth radar scan is shown below. The geometry is somewhat exaggerated to show the details. The shaded area shows the sweep coverage:

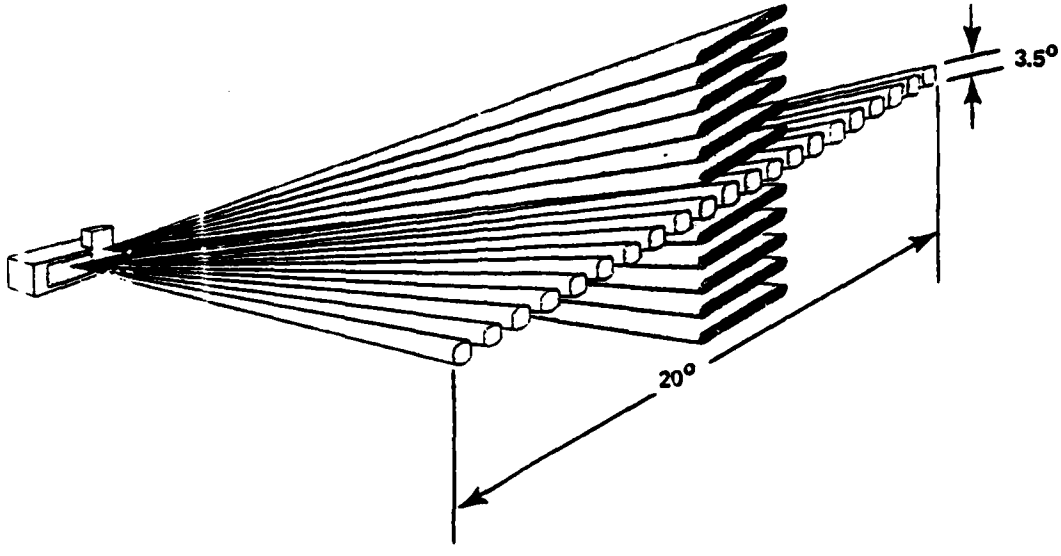


It is important to have this image clearly in mind when you interpret the PAR azimuth display. Here is a closeup of the display:



Notice that the electronically generated horizontal cursor corresponds with the centerline extension. You will recall that the vertical hashmarks are also generated electronically to show distance from touchdown.

Looking again at the radar scan as seen from the pilot's perspective, you can see that the azimuth sweep coverage is wide (20°), but not very high (3.5°).

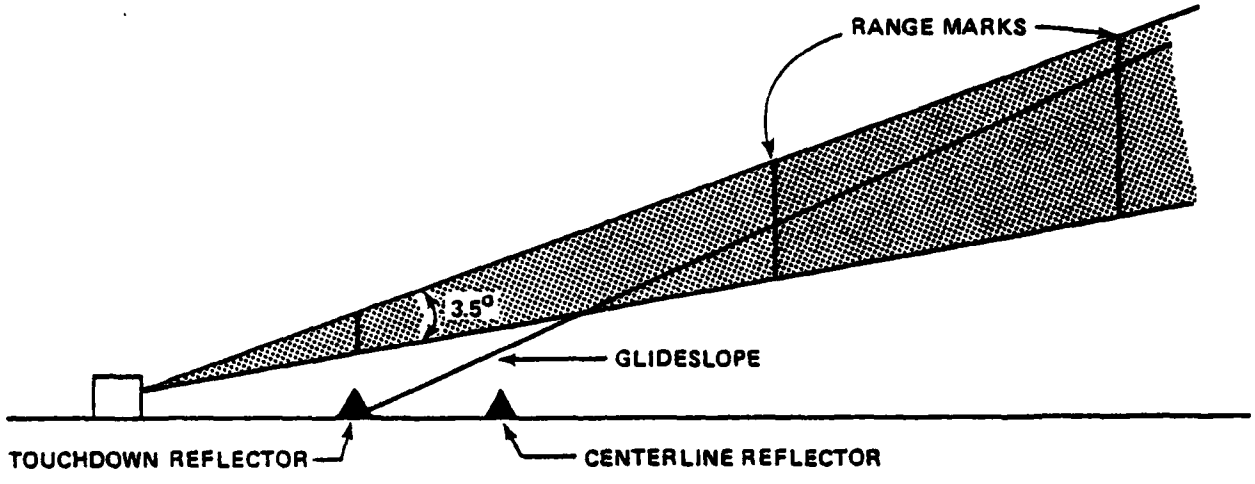


You have already learned that the azimuth antenna can be moved by means of the azimuth servo.

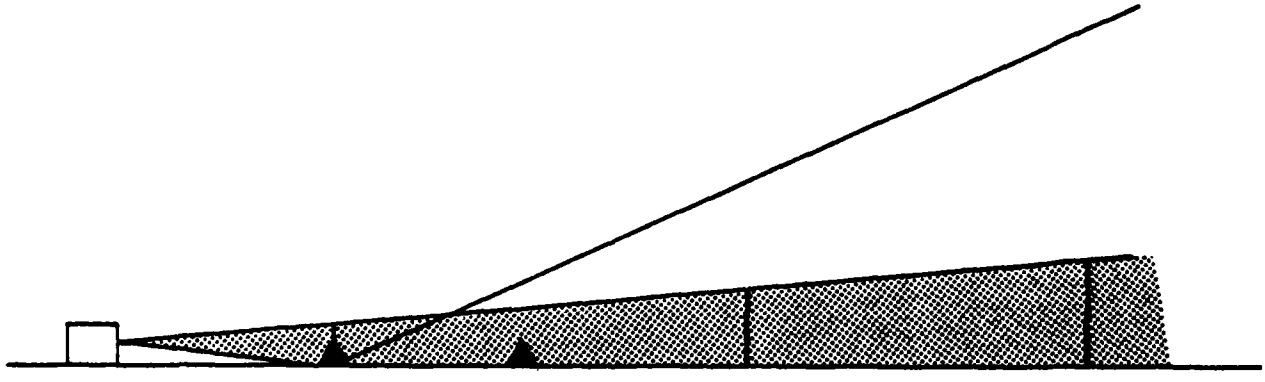
BEFORE TURNING THE PAGE

Visualize the servoing of the azimuth antenna. Which way does the antenna move? What happens to the sweep area as it moves?

Check your understanding of azimuth servo operation by referring to the drawings below. (The azimuth servo, of course, moves the antenna up and down.) Here the azimuth antenna is servoed up for normal operations.



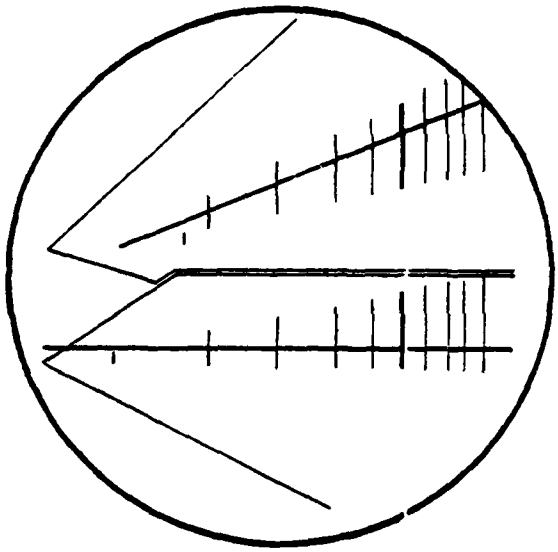
Below it is servoed down. In this position the centerline reflector, which is set at a height of six feet, would be visible on the display.



BEFORE TURNING THE PAGE

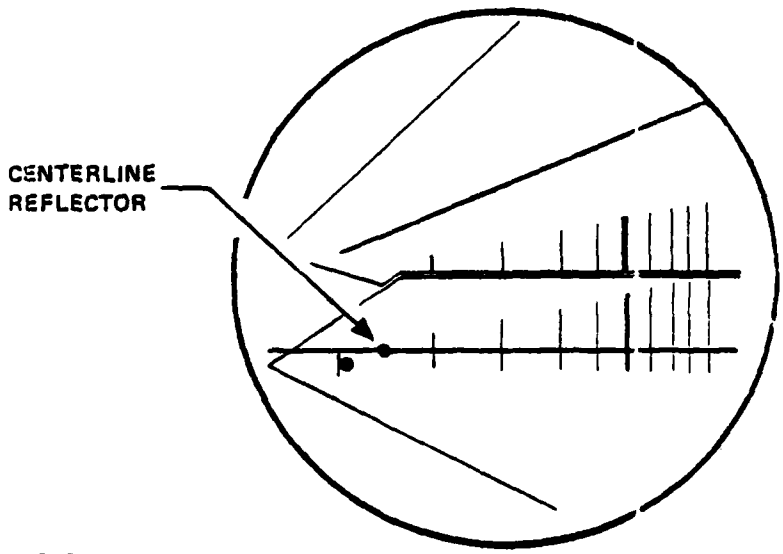
Visualize the PAR indicator. How does it look when the azimuth radar is in the normal position? When it is servoed down?

Check your recall by referring to these drawings. Here the azimuth antenna is servoed for normal operations.



Below it is servoed down. Notice two things:

1. The hashmarks on the elevation display move with the azimuth servo.
2. When the azimuth antenna is servoed down, the centerline reflector is visible on the azimuth display.

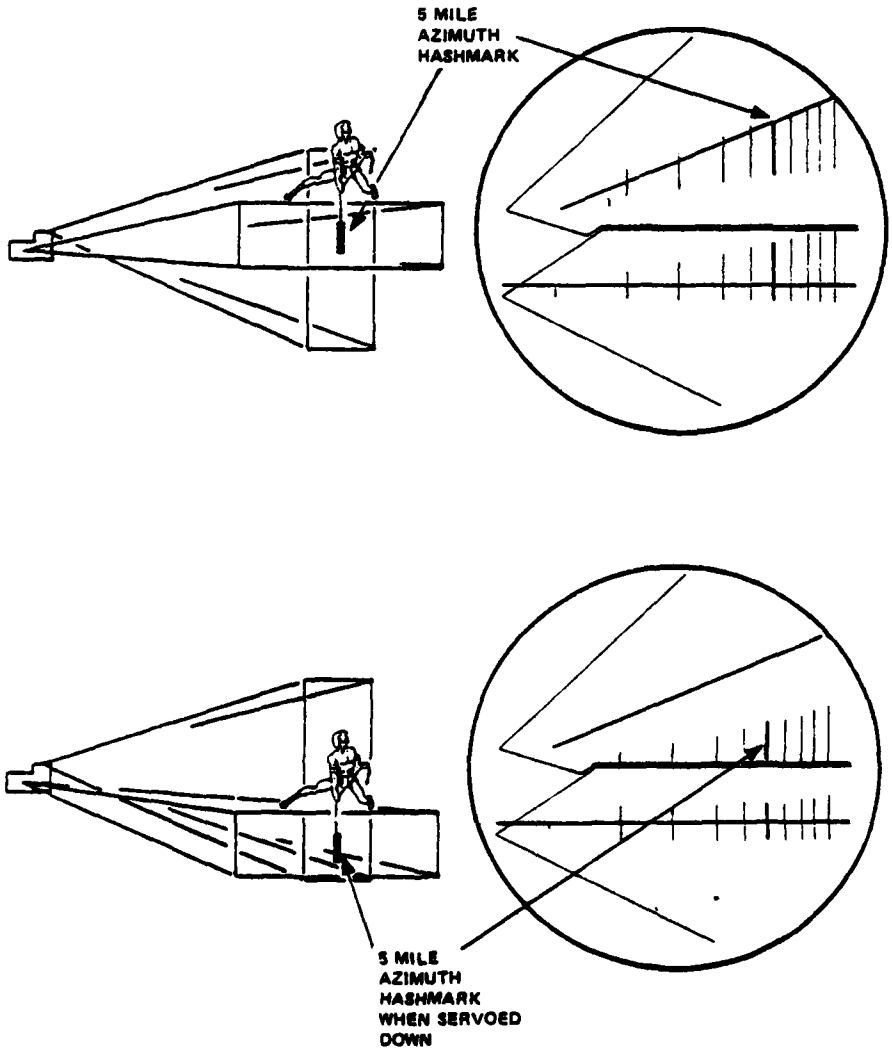


BEFORE TURNING THE PAGE

Why does it make sense that the hashmarks on the elevation display move with the azimuth servo? (Hint: Refer to the pictures on the previous page. Think of the hashmarks as being reflectors suspended in the azimuth beam.)

The scan of the azimuth antenna is left to right, however the antenna can be mechanically tilted (servoed) up and down. The range marks on the elevation display show the tilt angle of the azimuth antenna. These pictures may help explain it.

If you think of the hashmarks as imaginary reflectors which are suspended in the azimuth beam, it makes sense that their movement would show up on the elevation display.



In actuality, of course, the hashmarks are electronically generated on your PAR indicator.

2.2 CHECKING AZIMUTH ALIGNMENT

Before you can use your PAR system to control an aircraft on final approach, you must assure yourself that it is properly aligned. The importance of having a properly aligned system is obvious, since the cursors and range marks serve as the reference for all position calls. The azimuth cursor represents the extended center of the runway, and if it is not properly aligned, the information will be wrong. Remember that human life is at stake in air traffic control. Develop the habit of checking the alignment of your radar every time you take your post. Remember, you are responsible for ensuring that the gear is functioning properly.

****

THE LAW

Acceptability of the radar is a controller/ATC supervisor determination which cannot be usurped [taken over] by non-controller personnel.

****

In this level you will learn to check the alignment of the azimuth cursor with the centerline reflector. In later levels you will learn to align the elevation cursor and touchdown range mark. For now, concentrate on the azimuth alignment procedure. There are five steps to follow:

1. Ensure there is no aircraft on final approach
2. Servo down
3. Determine whether the radar is aligned
4. If it needs alignment, cause it to be aligned
5. Servo up

BEFORE TURNING THE PAGE

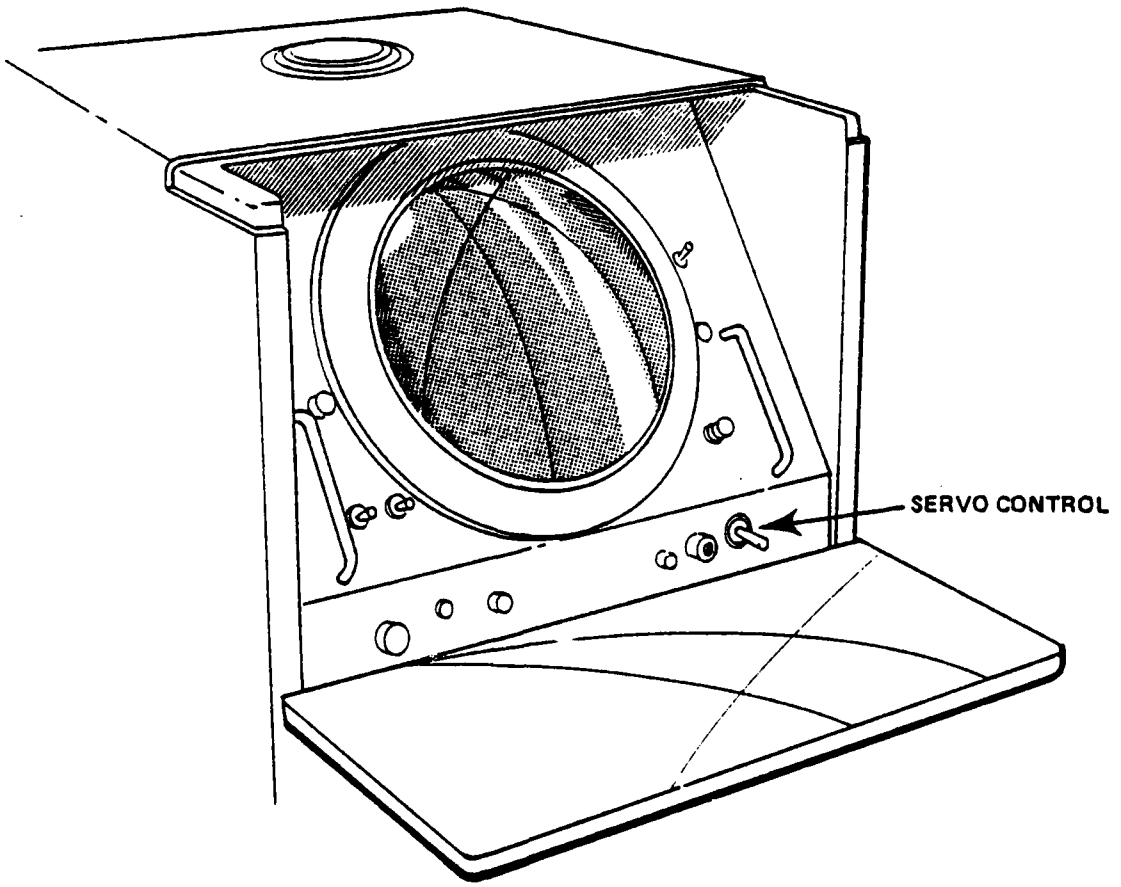
Visualize this procedure. Why is it necessary to servo down? (The pictures on page 25 show the answer.)

Let's take this procedure one step at a time.

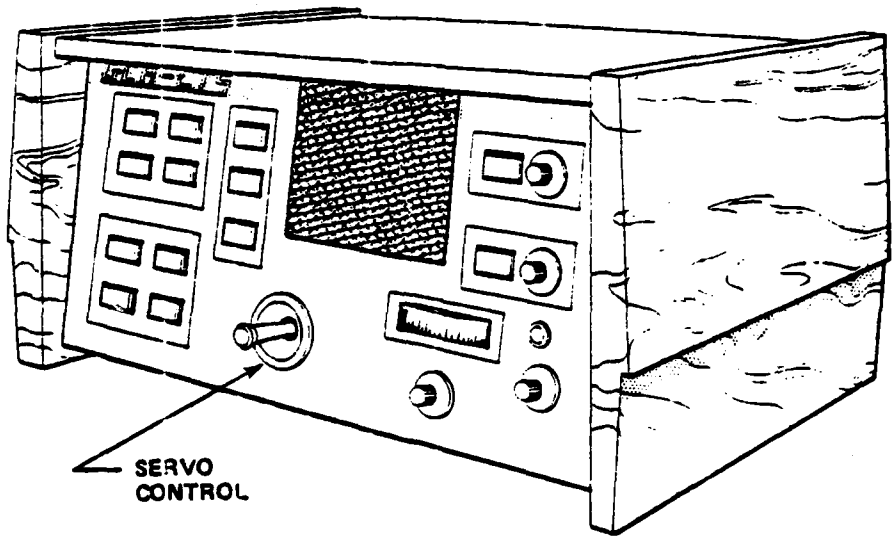
STEP 1. OBSERVE THE DISPLAY. Wait until there is no aircraft on final approach. The next step will change the position of the azimuth antenna and should not be done if another controller is using the system.

STEP 2. SERVO DOWN. Because the centerline reflector is only six feet high, it is too low to be visible on your indicator when the azimuth radar is servoed for normal operations. Therefore, you must servo down until you pick up the return from the reflector. Do this by pushing the servo down gently.

In the operational gear, the servo control is mounted on the PAR indicator cabinet in the lower right-hand corner.

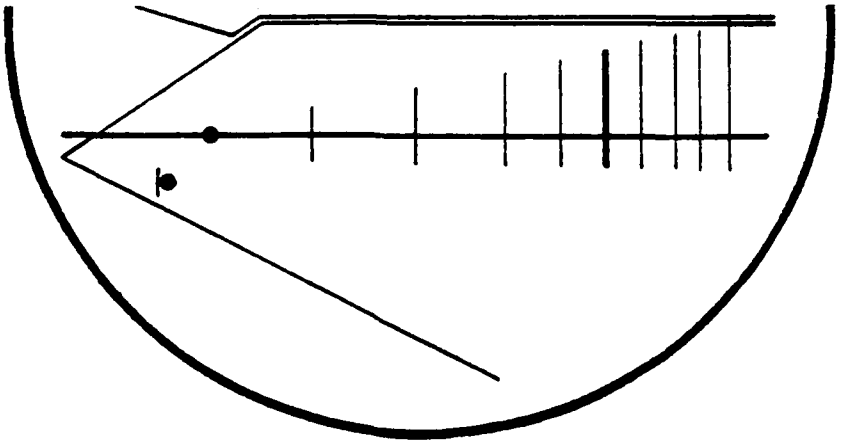


In the GCA-CTS, the servo control is mounted in a separate cabinet to the right of the simulated PAR indicator.

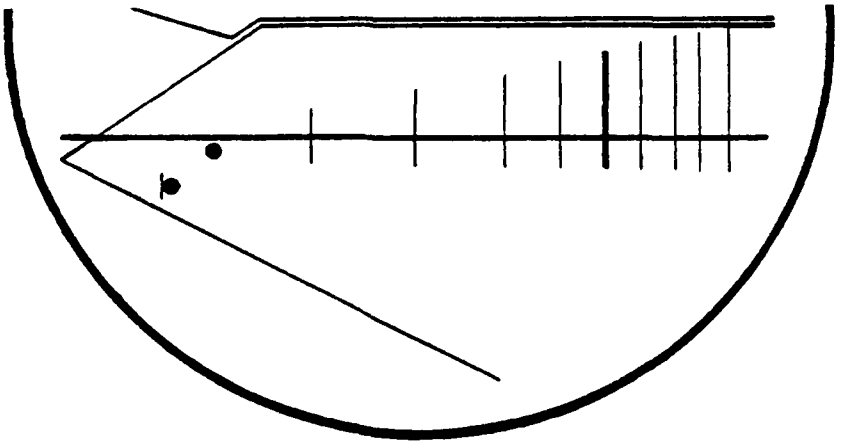


The GCA-CTS servo works the same way the operational servo does, despite the fact that it is mounted in a slightly different position. (There is a button in the top of the GCA-CTS servo control, but it doesn't do anything.)

STEP 3. CHECK THE ALIGNMENT. After you have servoed down to pick up the centerline reflector, observe your azimuth display. The azimuth cursor should bisect (cut in two) the video return of the centerline reflector like this:



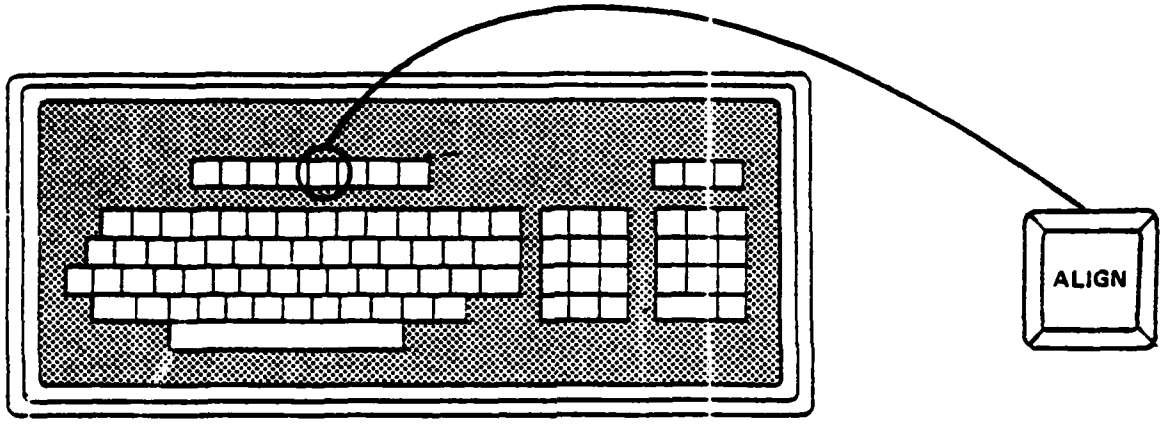
If your PAR indicator doesn't look like this, alignment is needed. Here is a case where the radar is not properly aligned. Observe the difference between these two pictures carefully.



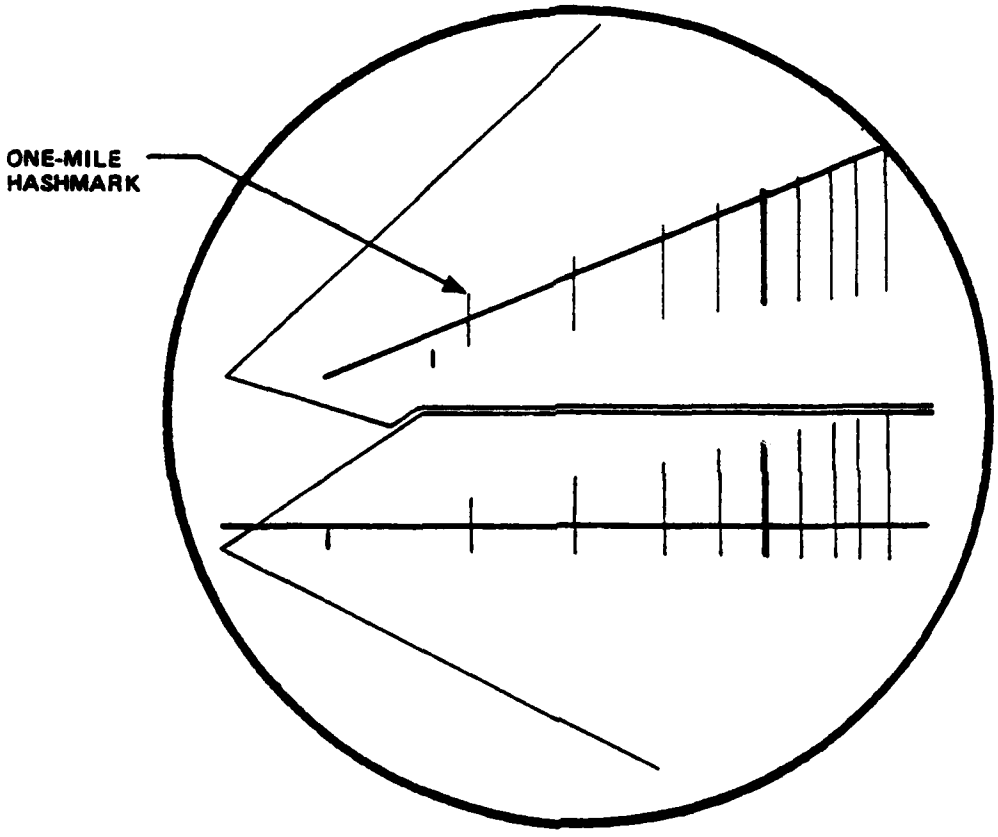
In the GCA-CTS, the centerline reflector looks like a small circle. On the operational gear it will look like a round bright spot.

STEP 4. CAUSE THE RADAR SYSTEM TO BE ALIGNED. In the operational environment the radar must be aligned by a technician. The proper procedure is to inform your supervisor that your indicator needs alignment.

In the GCA-CTS training environment no technician is needed, so the radar is aligned by pressing the ALIGN key on the keyboard. Do not press this key unless alignment is necessary because you will be graded on the accuracy of your alignment procedure.



STEP 5. SERVO UP. Once you have checked the alignment (and pressed the ALIGN key, if necessary) servo up for normal operations. If you failed to servo back up, inbound aircraft would not appear on the azimuth display. The azimuth servo is properly positioned when the one mile hashmark is bisected by the cursor on the elevation display.



CAUTION

In a live situation the same radar system may be in use by other controllers. Do not servo without first ensuring that no one else is using the system. If you are not careful, another controller could lose his target.

AZIMUTH ALIGNMENT CHECK PROCEDURE

SUMMARY

When you take your post and sign on:

1. Ensure there is no aircraft on final approach.
2. Servo down.
3. Observe the centerline reflector to determine whether or not it is bisected by the azimuth cursor.
4. If the centerline reflector is not bisected by the azimuth cursor, cause the radar to be aligned by:

   a. notifying the supervisor, in the operational environment
   b. pressing ALIGN, in the GCA-CTS

5. Servo up until the one mile hashmark is bisected by the cursor on the elevation display.

2.3 ACCEPTING THE HANDOFF

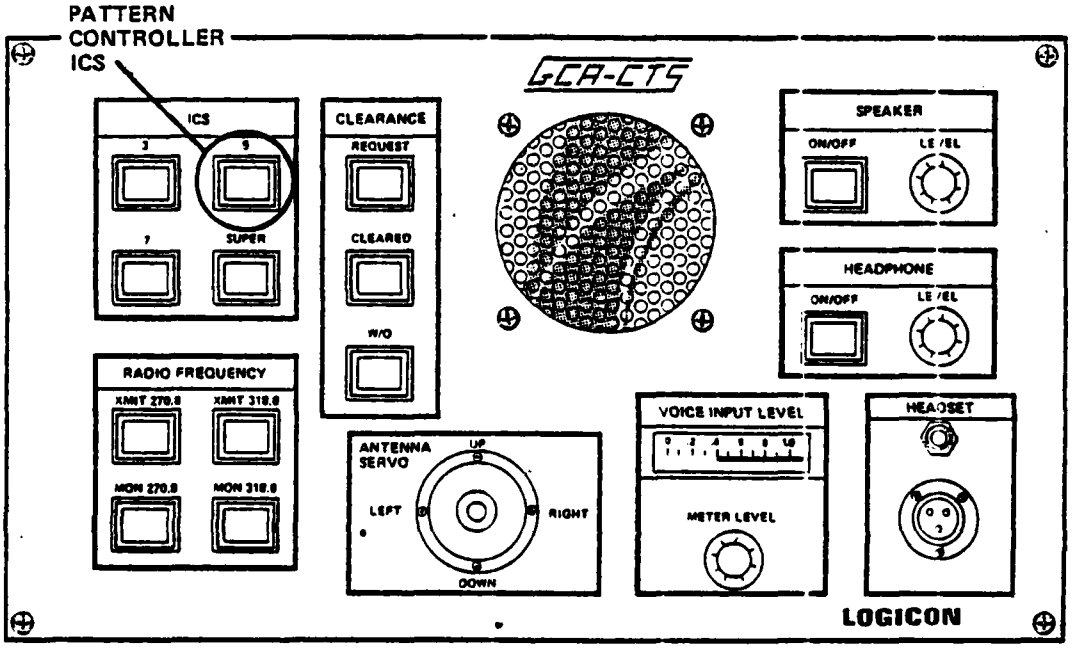
Surveillance radar procedures include the vectoring of an inbound aircraft to a point where the PAR can pick it up, and the handoff of the aircraft to the final controller. As a PAR controller, you will learn to accept the handoff and take responsibility for the control of the aircraft on final approach.

There are several steps to this procedure:

1. Listen for your position number and the handoff information
2. Roger the handoff message
3. Monitor the designated radio frequency
4. Inform the pattern controller when you have radar contact
5. Take over the radio frequency.

We will study this procedure one step at a time.

STEP 1. LISTEN FOR HANDOFF. As you have already learned, you can communicate with the pattern controller over the ICS. In the GCA-CTS, the pattern controller has ICS position 5. To monitor or to talk with the pattern controller, depress ICS button 5 on the panel.



The GCA-CTS ICS works the following way: When you depress a button, it will turn amber. When the pattern controller wants to talk with you, and the ICS 5 button is not already depressed, he or she will flash ICS 5 to alert you. You are ICS position 4.

During practice, when a problem requires you to accept the handoff, monitor ICS 5 to hear it.

The handoff message the pattern controller will use will include your position and information about the aircraft. An example is, "Position four, handoff, right base, Navy three one zero, P3, full stop, button one."

As a GCA controller, you must learn to listen for your postion number and remember the information given in the handoff. Every bit of it is important to the PAR controller. This table will help you see why.

Message	Importance
position four	Alerts you to the fact that the information which follows is intended for you.
handoff	This means that responsibility for the control of the aircraft will be transferred to you after radar contact is established.
right base	Informs you where the target will be when it appears on your indicator.
Navy three one zero	This gives the call sign which you will use in your communications with the pilot.
P3	This tells you that the aircraft is a turbo prop with an approach speed of about 130 knots. You will time your transmissions based upon this information.
full stop	The type of approach tells you what approach termination procedures to use.
button one	A nickname for the radio frequency used to communicate with the pilot.

STEP 2. ROGER THE HANDOFF MESSAGE. When you hear a handoff intended for you at position 4, you must inform the pattern controller by saying:

Position four roger

If you do not respond, the pattern controller will repeat the handoff. If you still don't answer, he or she will ask, "Position four, did you copy?" Before giving up on you, he or she will say, "Position four, over." The correct response to any of these is:

Position four roger

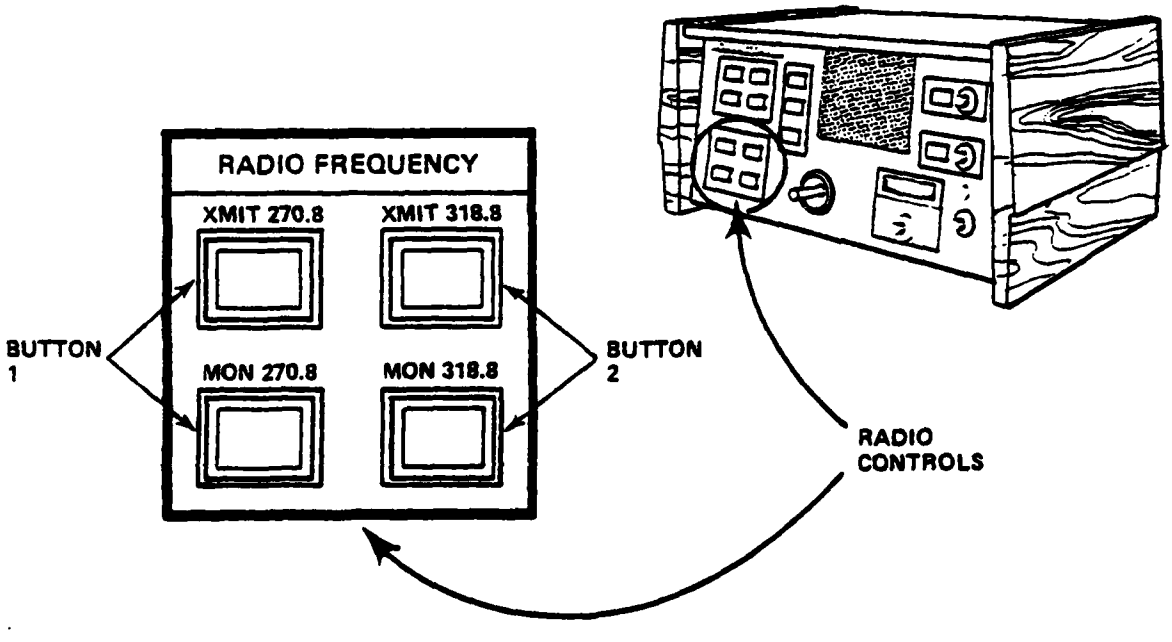
As a professional controller, you should always respond at once.

Remember that the GCA-CTS pattern controller will only be able to understand you if you use exact terminology in your communications. In fact, while the GCA-CTS is teaching you this procedure, the pattern controller will be learning to recognize the way you say this phrase. It may seem like it takes him a long time to learn simple phrases, but please be patient. After all, the pattern controller is only a computer!

STEP 3. MONITOR THE DESIGNATED RADIO FREQUENCY. The procedures you have been using require that each aircraft be assigned a different radio frequency for approach control information. Furthermore, only one controller can talk over that frequency at a time, although many controllers could monitor it. When the pattern controller gives you a handoff, you will observe that the upper half of the radio frequency XMIT button he or she specifies is glowing amber. This means the pattern controller has control of the frequency. It is not relinquished until you report radar contact. In fact, the pattern controller may continue to give messages after the handoff. It is important that you monitor these transmissions because they will:

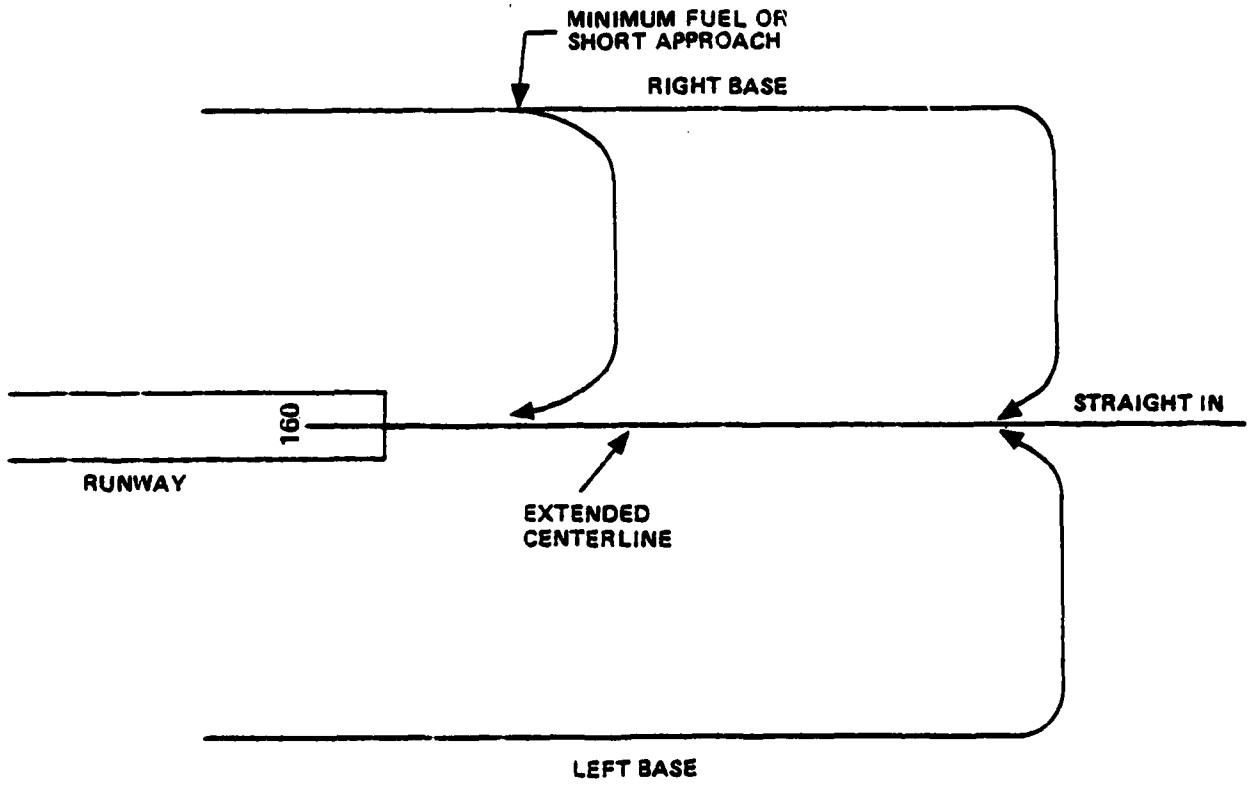
- Tell you the aircraft's assigned heading.
- Reinforce your memory of the call sign.

The GCA-CTS radio frequency XMIT and monitor buttons work just like the ones you are used to. Two frequencies are used, 270.8 and 318.8, and these are nicknamed button 1 and button 2. To listen to communications over the frequency, depress the MON button. It will glow amber when depressed.



Listen carefully to the pattern controller, especially to the heading assigned in the dogleg turn.

STEP 4. INFORM THE PATTERN CONTROLLER WHEN YOU HAVE RADAR CONTACT. The handoff message contained information about the aircraft's position. In the problems you will be given, there are four possible starting positions: left base, straight in, right base, and emergency aircraft making a short approach from right. However, most of the handoffs will be from right base at the GCA-CTS installation.

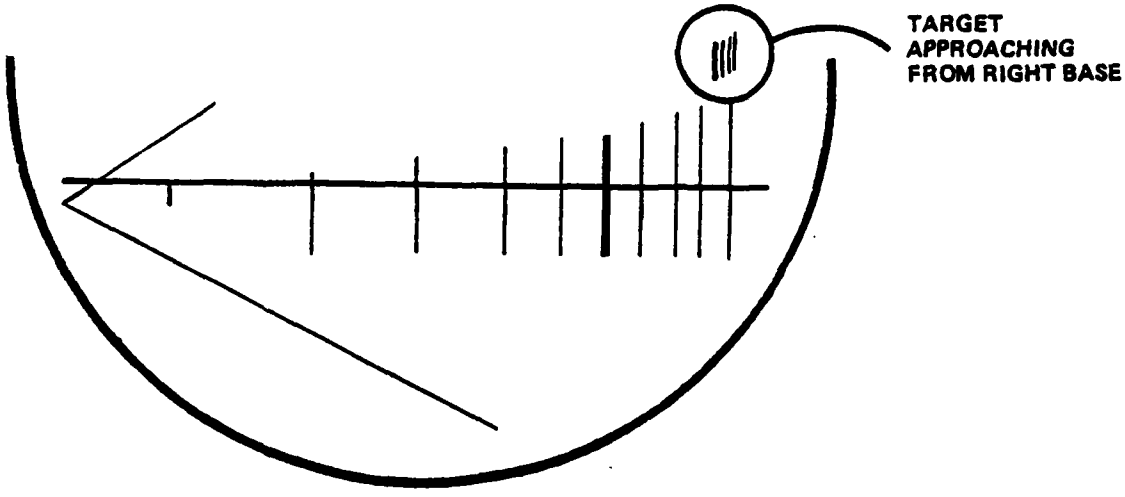


You must watch for the target in the appropriate area of your PAR indicator after the handoff.

BEFORE TURNING THE PAGE

Visualize a target coming in from right base. Where would it first appear on the azimuth display?

The target would appear first on the right side of the azimuth display.



A professional PAR controller always refers to the upper portion of the azimuth display as the right side and the lower portion as the left side. This reflects the fact that the PAR controller always takes the pilot's perspective.

When you see at least 50 percent of the azimuth target return, report this to the pattern controller by saying:

[Call sign] (pause)
Radar Button [#] (pause)

(The square brackets [#] mean that you have to fill in the correct phraseology.)

BEFORE TURNING THE PAGE

What would you say to inform the pattern controller that you had radar contact if your handoff was "Position four, handoff, right base, Navy three one zero, P3, full stop, button one?"

The appropriate radar contact message would be "Navy three one zero... radar button one." Did you remember to put in the pause (shown as "..." above)? The GCA-CTS pattern controller will not be able to understand you if you forget the pauses.

As soon as the pattern controller understands that you have the target, he or she should relinquish the radio frequency and the amber light in the XMIT button will go out. If the pattern controller forgets to give you the frequency you must remind him or her by saying:

Give me button one

or

Give me button two

STEP 5. TAKE OVER THE RADIO FREQUENCY. When the pattern controller relinquishes the radio frequency, you must take over the frequency so you can communicate with the pilot. You must also deselect the pattern controller's ICS button (he or she doesn't want to listen to you talking to the pilot!), and you should deselect the MON button as well. The recommended sequence is:

- Deselect ICS 5 (light will go out)
- Deselect appropriate MON button (light will go out)
- Depress appropriate XMIT button (light will turn green)

CAUTION

If you inadvertently depress one of the XMIT buttons while it is amber, an alarm will sound to alert you to the fact that another controller has that frequency. Deselect the button to stop the alarm.

ACCEPTING THE HANDOFF

SUMMARY

1. Select ICS 5.
2. Listen for a handoff to your position number such as, "Position four, handoff, right base, Navy three one zero, P3, full stop, button one."
3. Remember the information given in the handoff.
4. Roger the handoff message by saying, "Position four roger."
5. Monitor the designated radio frequency.
6. Inform the pattern controller when you see 50 percent of the azimuth target by saying, "[Call sign]...radar button [#]."
7. Select the radio frequency XMIT button as soon as the pattern controller relinquishes it (amber light goes out).
8. Deselect ICS 5 and MON.

2.4 ESTABLISHING COMMUNICATIONS WITH THE PILOT AND WHEEL CHECK

As soon as you have reported radar contact and have selected the radio frequency, establish communications with the pilot (and get a wheel check if necessary). Remember that in order to talk to the pilot, the appropriate radio frequency button must be selected (green light on). You can then transmit whenever you depress the foot key. Remember also to deselect the MON button and the ICS button.

STEP 1. RADIO CHECK. Establishing communications with the pilot can be done by saying:

[Call sign] (pause)
This is your final controller, how do you hear me? (pause)

Assume you have Navy three one zero. Practice making this transmission a few times. Be careful about the pauses!

****
*
* THE LAW
*
* Communications Check.
*
* On initial contact with the final controller, ask the
*
* aircraft for a communication check. Phraseology: THIS
*
* IS (name of facility) FINAL CONTROLLER. HOW DO YOU
*
* HEAR ME?
*
****

As soon as you unkey the transmitter, the pilot will respond to this radio check by saying, "Loud and clear" or "Weak but clear." If the response indicates your radio transmission was weak, check the positioning of the microphone. Also check to make sure that the level knob beneath the voice level meter on the communications panel is in the proper position. Any time the pilot informs you that your transmissions are weak, check your equipment, make any necessary adjustments, then you may ask the pilot:

How do you hear me now?

As a PAR controller you may find you have a great deal to do immediately after radar contact. For example, the aircraft may not be on the heading assigned by the pattern controller. There are two transmissions which can be substituted for the formal radio check because the pilot's response will assure you that you are in radio contact. These are:

1. A turn, such as:

   [Call sign] (pause)
   turn right heading (pause)
   one (pause)
   five (pause)
   zero (pause)
   over (pause)

   (You will learn more about the turn to final in the next lesson.)

or

2. A wheel check:

   [Call sign] (pause)
   wheels should be down (pause)
   over (pause)

Whenever "over" is used, the pilot will respond (assuming you unkey the transmitter). In most cases, the pilot simply rogers the transmission. If "over" is used after a turn, the pilot will repeat the turn he or she understood.

STEP 2: WHEEL CHECK. A wheel check must be conducted in the initial phase of the approach unless the pilot volunteers the information that his wheels are down. Normally the sequence would be:

1. Conduct the radio check
2. Conduct the wheel check by saying

> [Call sign] (pause)
> wheels should be down (pause)
> over (pause)

As you learned earlier, the wheel check can be substituted for the radio check if you do not have time for both transmissions. Sometimes the pilot will respond to the radio check and in addition, report "wheels down and locked." Do not give the wheel check if the pilot beats you to it!

THE LAW

Wheels Down Check.

Before the aircraft starts descent on final approach, remind the pilot that wheels should be down unless he has previously reported wheels down. (NOTE: The intent is solely to remind the pilot to lower the wheels, not to place responsibility on the controller.)

Phraseology: WHEELS SHOULD BE DOWN.

RADIO AND WHEEL CHECK

SUMMARY

1. Key the mike.
2. Conduct the radio check saying, "[Call sign]...this is your final controller how do you hear me?
3. Unkey the mike.
4. If the pilot doesn't volunteer that the wheels are down, key the mike, say, "[Call sign]...wheels should be down...over" and unkey.

GRADING

When you practice these procedures, the system will grade you separately on accepting the handoff and on the radio check. These are the procedures it checks. The wheel check won't be graded until Level Four.

ACCEPT HANDOFF

		Partial Credit	Total Possible Points
A.	Monitor pattern controller ICS	10	
B.	Monitor proper frequency as specified in the handoff	10	
C.	Acknowledge handoff		
	1. Acknowledgement given prior to radar contact	10	
	2. Acknowledgement given within 10 seconds	10	
D.	Report radar contact		
	1. Radar contact reported prior to radio check	10	
	2. 50% of target on display at report	15	
	3. Report not later than 10 seconds after 50% target appearance	15	
	4. Call sign correct	5	
	5. Radio frequency correct	5	
E.	ICS off, radio frequency selected		
	1. If pattern does not relinquish frequency, "give me..." request is made within 15 seconds; otherwise not	5	
	2. When pattern relinquishes frequency, ICS is deselected	5	
			100

GRADING (Continued)

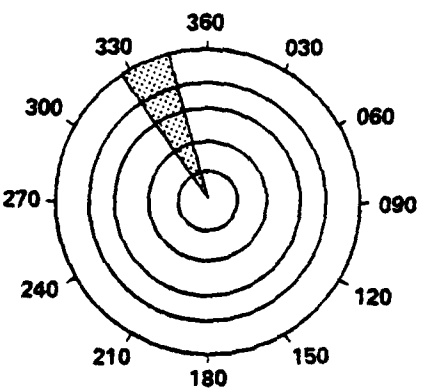
RADIO CHECK

	Partial Credit	Total Possible Points
A. Radio contact		
1. Within 30 seconds of the appearance of 50% of the azimuth target	10	
2. Proper frequency selected	10	
3. Mike keyed	10	
4. Call sign used	10	
5. One of the following given:	10	
a. "How do you hear..."		
b. "Wheels..."		
c. "Turn...heading"		
d. "Turn..."		
6. Unkey within 3 seconds and remain unkeyed 5 seconds	20	
B. Speech quality		
1. Pilot responds "Loud and clear," or	30	
2. If pilot responds "Weak...,"		
a. Student answers "How...now," unkeys within 3 seconds and remains unkeyed 5 seconds	15	
b. Pilot can respond "Loud...," i.e., voice level normal	15	
		100

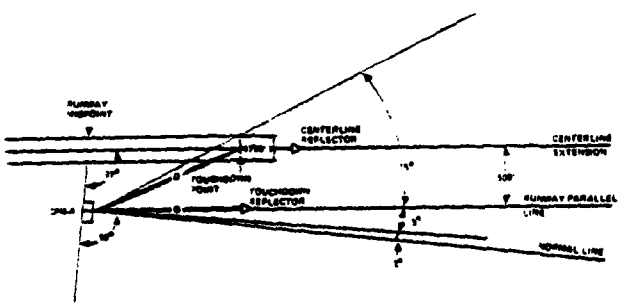
2.5 THE TURN TO FINAL

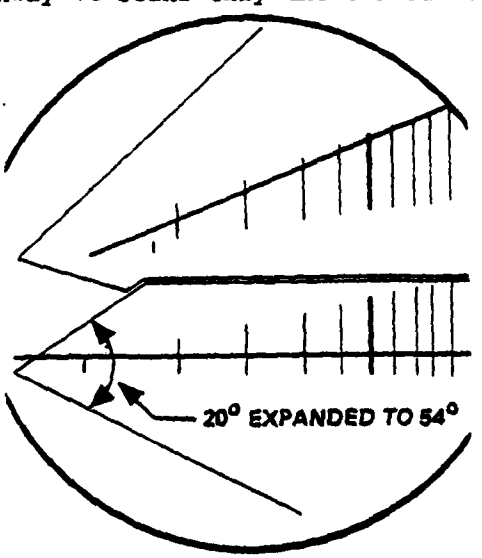
If the aircraft is approaching from right or left base, the pattern controller will have given the dogleg turn. Your job will be to vector the aircraft to the final approach heading. Before you can execute a turn to final, you must learn to interpret the azimuth indicator to give course corrections. We will look closely now at the difference between the PAR azimuth indicator and the ASR indicator with which you are familiar.

The ASR indicator provides a 360° scan of traffic in the terminal area. You might say it shows the whole pizza! The display is aligned with magnetic north, and concentric, equally spaced rings indicate range to touchdown.



In contrast, the PAR azimuth radar for runway 16 scans only the shaded 20° slice of this 360°.





The PAR azimuth wedge is automatically positioned so that the centerline is always horizontal, no matter what the actual runway heading is. The GCA-CTS runway heading is 160°. In addition, the actual 20° beam width is expanded to 54° on the indicator.

It will take some practice to get used to the distortion caused by indicator expansion. It is because of this expansion, though, that precision control is possible.

For conducting PAR approaches, as in ASR approaches, it is important to take the pilot's perspective. Always imagine that you are sitting next to him or her in the aircraft. In this way your turn instructions will always be in the correct direction.

After the handoff, radio and wheel check, your job is to issue a series of turns so that the aircraft will be centered and tracking on the azimuth cursor.

We want to avoid overshooting the centerline extension and correcting for the correction, which is called "S" turning. Once "S" turning has started it's hard to stop. The best defense against "S" turning is to make a good turn to final. A good turn to final will take into consideration both the number of degrees to turn and the speed of the aircraft. Approach speeds of some representative aircraft are given below. Only a few of these are used in the GCA-CTS.

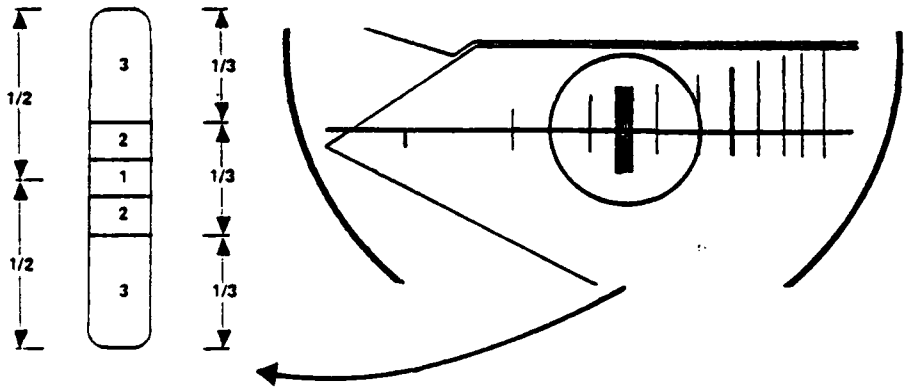
Type	Approach Speed (kts)
PA18	65
OV10	76
T34	85
U-21*	98
C-2	110
A6*	115
F14	120
A4	125
A7	125
727	130
F4	130
P3*	130
747	130
L1011	138
T38*	156

*Used in the GCA-CTS.

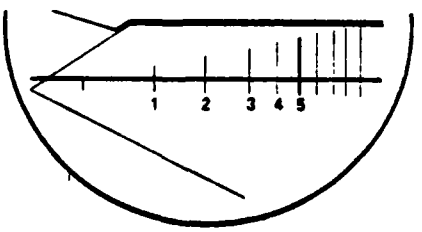
By now, you should be familiar with the process of "leading" an aircraft through a turn. This means issuing the turn in plenty of time for the pilot to react to your instructions and to make the 3° per second turn to the assigned heading. Although reaction time may vary from pilot to pilot, each aircraft takes about the same amount of time to execute a given turn because each pilot executes a STANDARD RATE TURN OF 3° PER SECOND. However, since the approach speeds of the various aircraft are different, faster planes will require a greater distance to execute a turn.

Once you know the aircraft's approach speed you will be able to develop a feel for when to turn the aircraft so that it ends up on centerline. The way you accomplish this turn is a matter of personal style, and therefore we will describe a good procedure and then encourage you to practice to develop your own style.

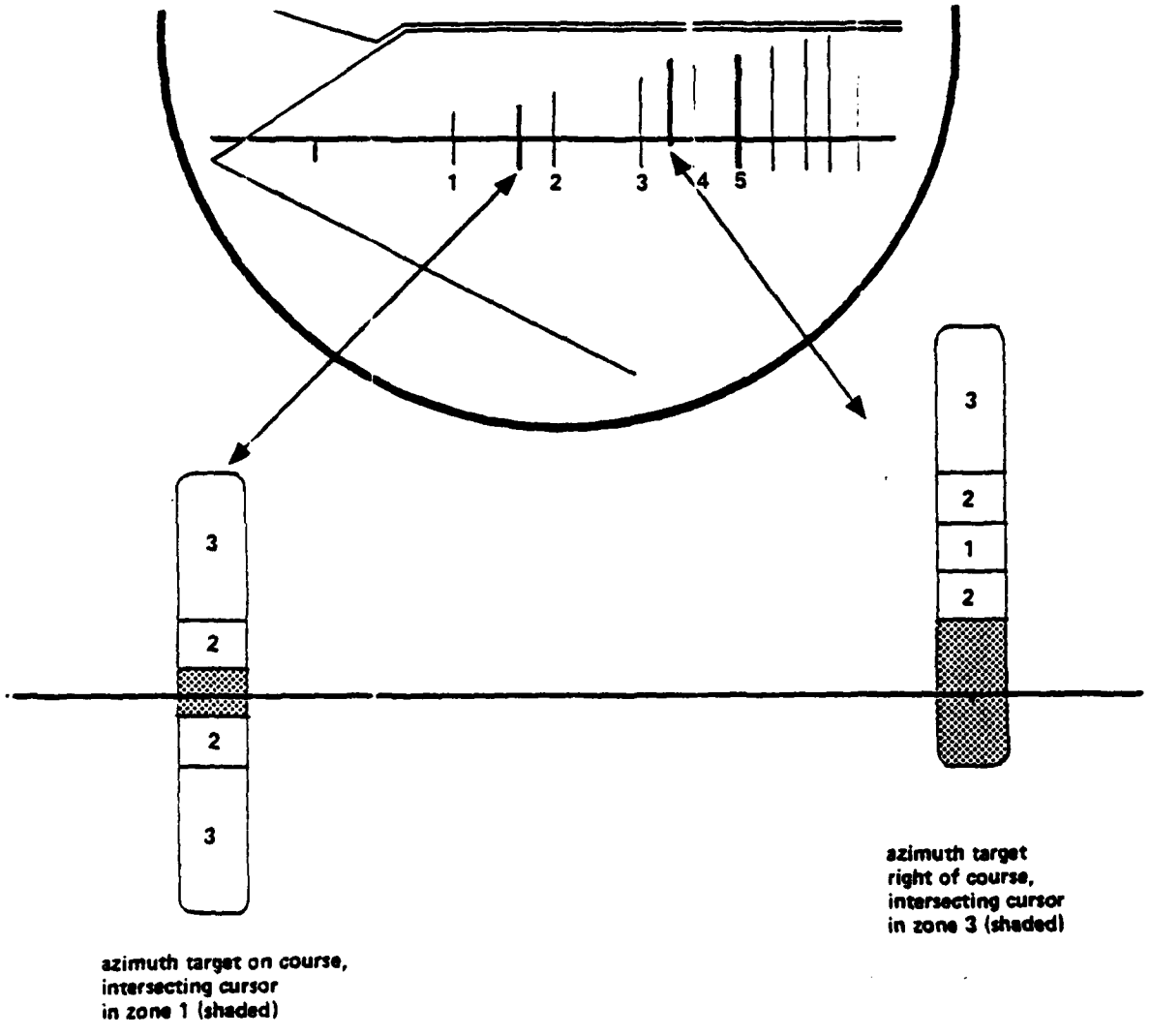
Let's start by looking carefully at the target itself. If it is visually divided into thirds, the resulting zones can be labeled like this:



You should memorize this target division since we will refer to it many times. To check your understanding, draw an azimuth target on the picture below at about 1 1/2 miles which is intersecting the azimuth cursor in zone 1. Draw another at about 3 1/2 miles which is right of course, intersecting in zone 3. (The mile marks are labeled for you.)



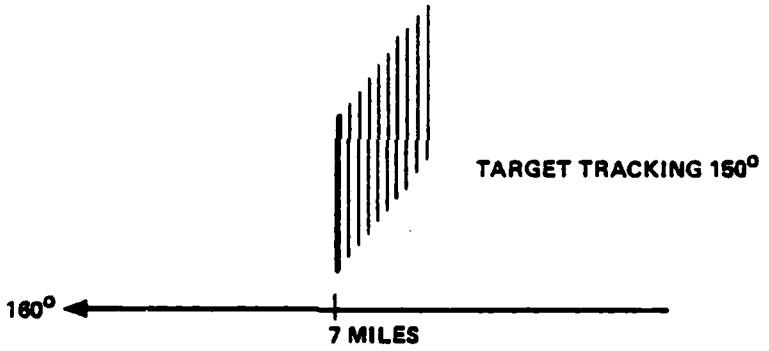
This is the way your picture should look.

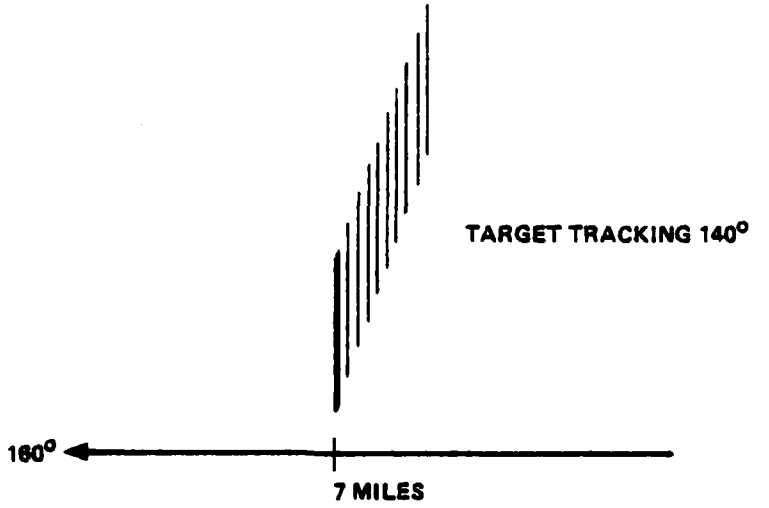


A good turn to final places the aircraft on the azimuth cursor and intersecting in zone 1 or 2.

In theory you could give just one turn to bring the aircraft on to the final approach heading. In practice it is difficult to give one large correction at precisely the right moment, and it leaves no room for pilot error. If the pilot is slow to react, for instance, overshoot will be inevitable. Therefore, most experienced controllers give several turns of not less than 5° in the direction of the final approach heading. This technique will enable you to gauge the pilot's responsiveness and skill, and to effect a smooth, accurate turn to final.

Your first step should be to estimate the aircraft's actual track heading. You know the heading given by the pattern controller, but you must observe the target trail to determine how the track is being affected by wind. The track heading can be determined by looking at the angle of the target trail with respect to the azimuth cursor. However, the expansion on the PAR indicator takes a little getting used to, because angles appear to be bigger than they actually are. Here are some examples:

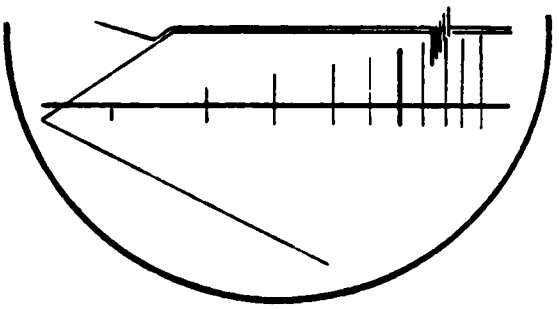




The reason for the expansion of angles on the PAR indicator is this: The expanded display makes even small differences in heading easy to observe.

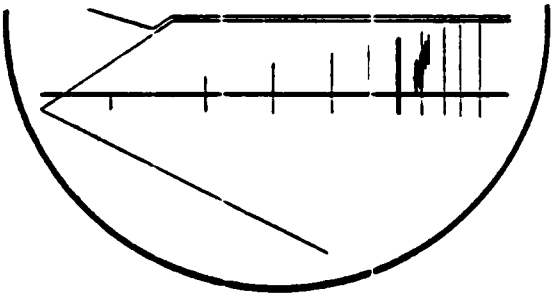
Now we will work through an example of a turn to final from right base for a medium speed aircraft, assuming there is no wind. Say the transmissions to yourself as you visualize the radar display. Be sure to pause slightly wherever you see "..." in the transmission. The GCA-CTS pilot will not be able to understand you unless you are very careful to pause.

This picture shows an aircraft on 140° approaching from right base. When the target is about 1" from the azimuth cursor, give the first correction to heading 150°. Which direction will you tell the pilot to turn? Of course, you tell him or her to turn right heading 150°.



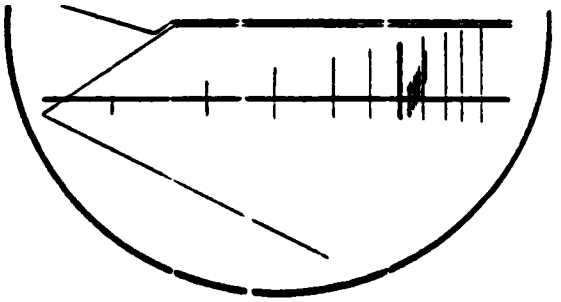
"[Call sign]... turn right heading... one...five...zero...over"

When the target first touches the azimuth cursor, issue another correction to heading 155°.



"[Call sign]... turn right heading... one...five...five...over"

Finally, as the target moves across the cursor so that the cursor intersects zone 2, issue a correction to heading 160°.



"[Call sign]...turn right heading... one...six...zero...over"

2.6 AZIMUTH CORRECTIONS ON FINAL

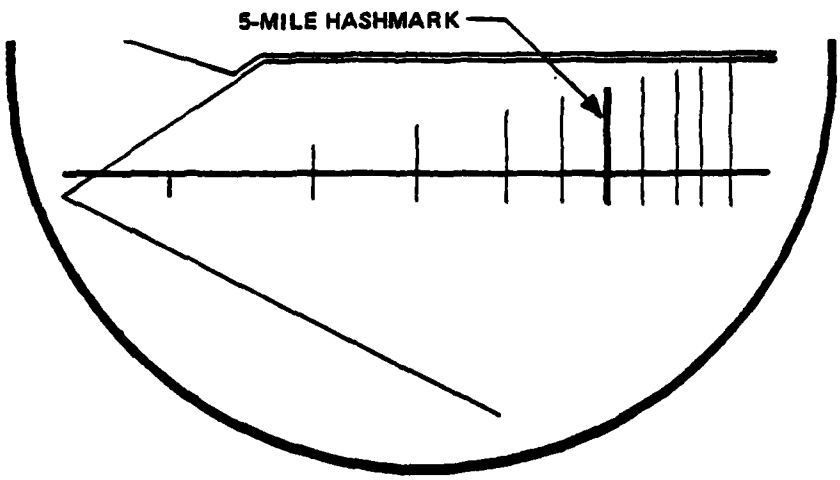
Even if you make a good turn to final, it may be necessary to issue course corrections on final. A good approach would be one in which the aircraft stays in zone 1 or 2 all the time. If the aircraft is paralleling the centerline in one of these zones, don't issue a turn. However, if it drifts away from the centerline into zone 3, you must issue a correction.

In principle, PAR course corrections are the same as those for ASR. However, because of the greater degree of accuracy possible with PAR, very small turns may be issued within five miles of touchdown and the aircraft response can be accurately observed.

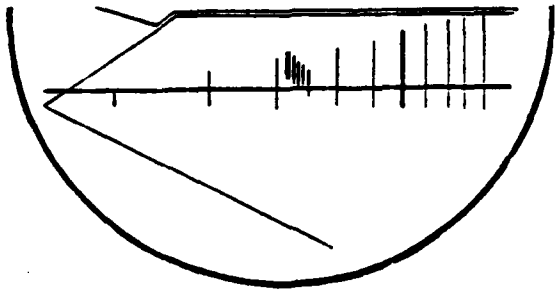
The rules are:

- Outside 5 miles, give corrections which are evenly divisible by 5°. Usually this means your corrections will be 5° or 10°.
- Inside 5 miles, use corrections of 2°, 3°, 5° or multiples of 5°. (The pilot's instruments are not calibrated to enable him or her to make a 1° correction.)

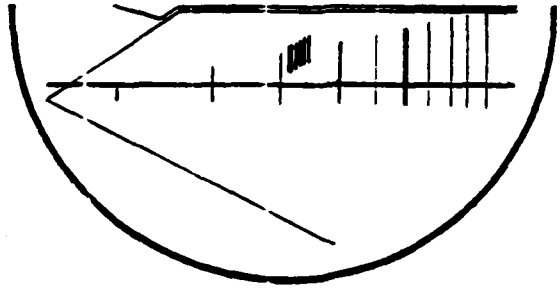
Notice that the 5-mile range mark is intensified to help you pick it out at a glance.



The key to making good corrections on final is the use of the target trail. Concentrate on it! In both cases below the target is in the same position. However, the trail reveals that different corrections are needed in each case. In the first case, the aircraft is drifting off course and a corrective turn is needed. In the second case, the correction is almost complete and a counter-corrective turn must be given.



corrective turn needed:
"turn left heading...
one...five...five"*



counter-corrective turn needed:
"turn right heading...
one...six...zero"*

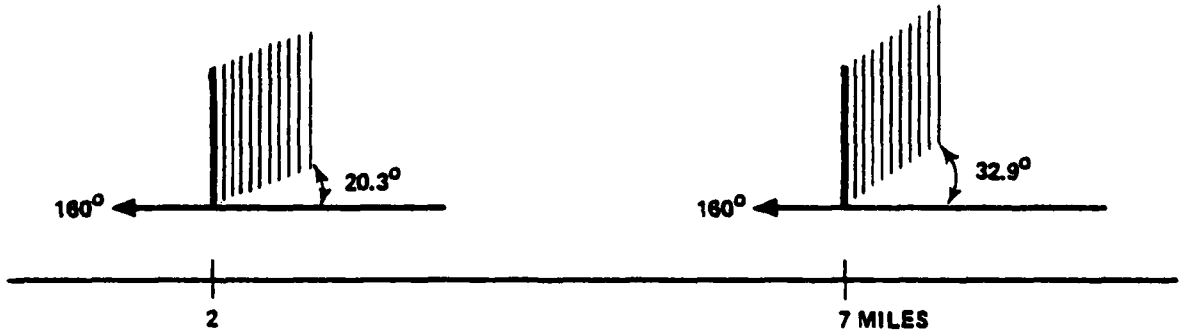
*After "do not acknowledge further transmissions," call sign and over are not used.

In formulating a good correction, it is important to be able to judge the aircraft's actual heading by looking at the target trail. You will recall from the discussion of the turn to final that the expansion in the azimuth display causes these angles to look larger than they are. This distortion becomes smaller as the target approaches touchdown. The table below will give you an idea of various angles of inclination of target trail, relative to centerline, at different ranges. You don't have to memorize it. It is included because you may find it interesting.

Actual Heading (relative to runway heading)

Range (miles)	5°	10°	20°	30°	45°
0	14.6	27.6	47.2	59.7	71.4
1	17.5	32.4	52.6	64.3	74.4
2	20.3	36.8	57.0	67.8	76.7
3	23.1	40.6	60.6	70.4	78.4
4	25.7	44.1	63.5	72.5	79.7
5	28.2	47.2	65.9	74.2	80.7
6	30.6	50.0	67.9	75.6	81.6
7	32.9	52.5	69.6	76.8	82.3
8	34.4	54.0	70.6	77.5	82.7
9	37.2	56.8	72.4	78.7	83.4
10	39.1	58.6	73.5	79.4	83.9

Study the diagram carefully to be sure you understand the table. It shows an aircraft tracking 155° at 2 miles and at 7 miles. The apparent heading drawn from the tables above is shown.



2.7 AZIMUTH CONTROL WITH WIND

The controller's life would be pretty simple if it weren't for wind! In your practice sessions, as you become familiar with the procedures, the system will select problems for you that include a variety of wind conditions. The wind indicator in the upper left-hand corner of your display will show you what the wind is doing at any given time. You should learn to adjust your heading vectors to account for wind. Watch the target trail – if the pilot is on the assigned heading you can observe the effect that wind is having on the aircraft track and compensate for it by keeping the aircraft pointing slightly into the wind (crabbing).

This table shows good values of crab for the four aircraft used in the GCA-CTS under a variety of wind conditions. Don't worry – you don't have to memorize it! These crab angles are shown to give you an idea of the strategy a good controller uses to counter wind. In the practice sessions and in live control situations, the wind is constantly changing in direction and speed. The table can only give you a general guideline to follow until you develop your own personal style and feel for good control procedures.

Aircraft Type	Wind Speed (Knots)	Relative wind heading (degrees) 0	1-10	11-30	30+
U-21	0	0	0	0	0
	1-10	0	2	3	7
	11-20	0	3	7	12
	21+	0	5	10	18
A6	0	0	0	0	0
	1-10	0	2	3	5
	11-20	0	2	5	10
	21+	0	3	8	17
P3	0	0	0	0	0
	1-10	0	2	3	5
	11-20	0	2	5	10
	21+	0	3	7	15
T38	0	0	0	0	0
	1-10	0	2	2	5
	11-20	0	2	5	8
	21+	0	2	7	12

It really isn't such a complicated table. Let's take an example. Suppose the wind is blowing from 180° at about 15 knots angling across the GCA-CTS runway. If you had a U-21 on centerline, the heading you would give to keep it paralleling the centerline would be 167°. Do you see why? Since 180° is 20° relative to the centerline (160°), choose the column labeled 11-30 degrees. Then find the set of crab angles for the U-21, and the row marked 11-20 knots. The crab angle is 7°. Since you want it to nose into the wind, the course would be runway heading plus crab or 160° + 7° = 167°.

BEFORE TURNING THE PAGE

With the same wind conditions, what headings would you give an A6, P3 and T38 to keep them paralleling the centerline?

The answers are: A6: 160°, P3: 165°, and T38: 165°.

THE HEADING MEASSAGE. A filler transmission which can be used when you do not need to give a turn is:

Heading (pause)
[digit] (pause)
[digit] (pause)
[digit] (pause)

The pilot does not turn when he or she hears this transmission so you must be careful that the heading message uses the same digits as the last turn given. Don't use this transmission more than five times per approach. (This can be confusing if this transmission is used improperly prior to the do not acknowledge message. If you say "Turn right heading...one...five...five" then say "Heading...one...six...zero...over," the pilot will roger that he heard 160 but will not turn.)

IF YOU MAKE A MISTAKE. You should know what you are going to say prior to making any transmission. Once you have started a transmission, speak with authority and complete it. If you realize you have made a mistake, continue to key the transmitter. But pause, say "Correction," pause again and issue the correct message. Once the transmitter is unkeyed, it is too late to correct. You will not be penalized for a mistake if it is corrected in this way.

GRADING

TURN TO FINAL

When you practice these procedures, the system will check the following points.

	Partial Credit Turn	Partial Credit Straight In	Total Possible Points
A. Accuracy of turn transmissions, if given (maximum of 3 turns scored).			
1. Turn(s) in proper direction	40		
2. Call sign correct	20		
B. Quality of turn or initial control			
1. At 6 miles (3 for short approach) target is within 2 target widths of cursor	10	30	
2. At 5 miles (2 for short approach) target must intercept azimuth cursor in target zone 1 or 2	20	70	
3. More than 1 turn should be used to turn aircraft into final	10		
			100

GRADING

HEADING VECTORS ON FINAL

		Weighting Factor Applied to Percentage Error	Total Possible Points
A.	Range greater than 5 miles; all turns must be evenly divisible by 5°	.1	
B.	Range less than or equal to 5 miles, turns must not be of 1°	.1	
C.	All heading vectors		
	1. The turn is not a "360°"	.2	
	2. A counter-corrective turn must be made within 8 seconds when a turn of more than 120° is given	.05	
	3. If the target enters zone 3 from zone 2, a heading correction must be given within 20 seconds. This check is initiated when target has been in zones 1 or 2 for 1/2 mile, or at 5 miles (2 for short approach), whichever comes first	.15	
	4. The heading given in the "Heading..." message must be the same as previously assigned	.25	
	5. "Heading..." must not be used more than 5 times in an approach	.15	
			100

LEVEL TWO

RADIO TERMINOLOGY SUMMARY

(All transmissions are over the radio frequency unless otherwise noted.)

Event	PAR controller response	Purpose
Pattern controller says "Position four, handoff,..." or "Position four, did you copy?" or Position four, over"	Over ICS 5, "Position four roger"	Acknowledges the handoff
50% of the target appears on the azimuth display	Over ICS 5, "[Call sign]...radar button [#]"	Informs the pattern controller that radar contact has been made and the specified frequency can be released
Pattern controller fails to relinquish the frequency	Over ICS 5, "Give me button [#]"	To remind the pattern controller to relinquish the frequency
Radar contact is made	"[Call sign]... this is your final controller how do you hear me?"	Radio check
Pilot responds, "Weak but clear"	"How do you hear me now?"	Radio check
Pilot does not advise "Wheels down and locked"	"[Call sign]...wheels should be down...over."	Radio check
Turn to final is needed	"[Call sign]...turn [right/left] heading... [digit]...[digit]... [digit]...over"	Turn to final
Azimuth correction on final	"Turn [right/left] heading...[digit]... [digit]...[digit]."	Azimuth correction
Filler	"Heading...[digit]... [digit]...[digit]."	Reminds pilot of assigned heading
Mistake is made	"Correction"	Informs the pilot that the last advisory should be ignored and that a correct one will follow

LEVEL THREE

AZIMUTH POSITION AND TREND, RANGE INFORMATION, CLEARANCE PROCEDURES

3.0 INTRODUCTION

In this level you will learn more about azimuth control procedures, and also learn to coordinate with the tower. You will learn:

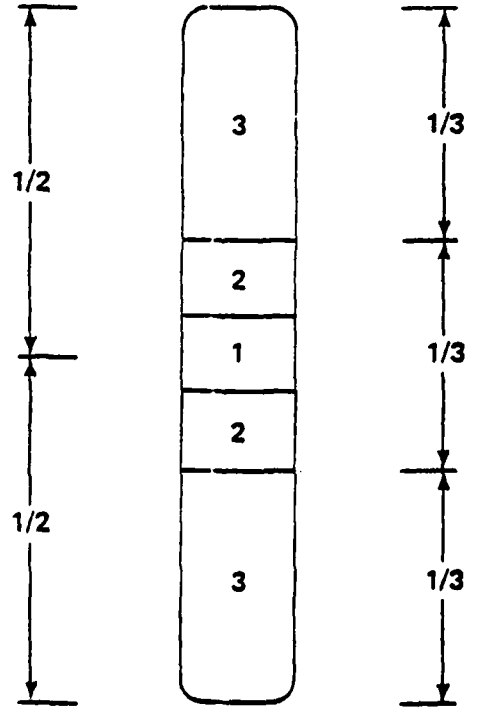
- To issue course position information
- To check range mark alignment
- To issue range to touchdown information
- To request clearance
- To convey wind information to the pilot
- To convey clearance information to the pilot.

3.1 COURSE POSITION INFORMATION

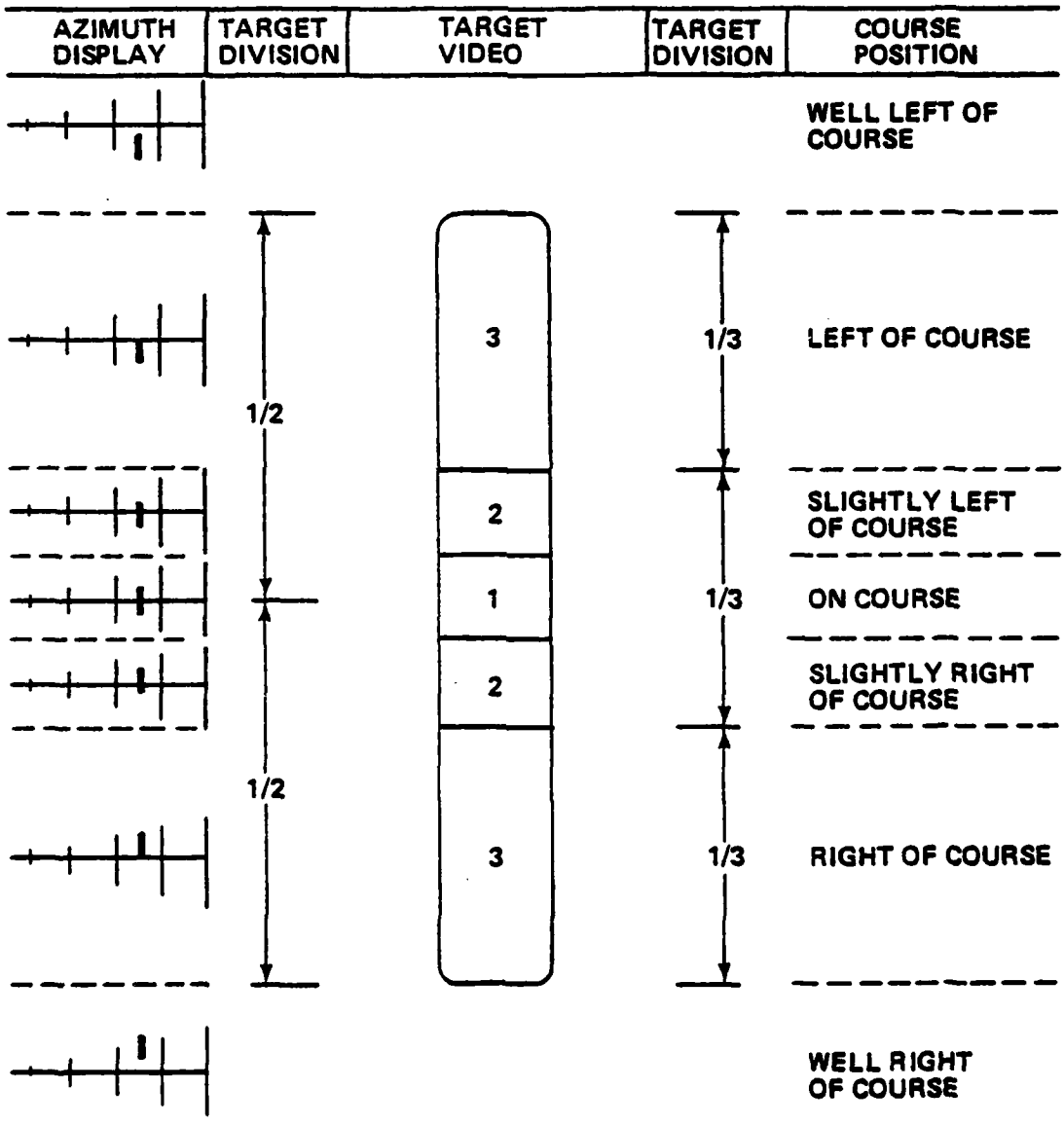
Course position information calls are important filler transmissions. Although the pilot does not actually turn in response to course position information, these advisories help him to maintain a good idea of where the runway is. Imagine yourself up there in IFR conditions — you would want to know exactly where to be looking for those approach lights, wouldn't you? You can see how important it is that your course position information be accurate!

With your PAR indicator, you will be able to see the aircraft's position much more clearly than you could on the ASR indicator. You must learn to use precise terminology so you can convey this information to the pilot. After all, in bad weather, you must take the place of his or her eyes!

The course position information is based on the target zone which is touching the azimuth cursor. The division of the target was described in Level 2, but you should review it to make sure you understand it. Remember that the target is visually divided into thirds, and the zones are numbered like this:

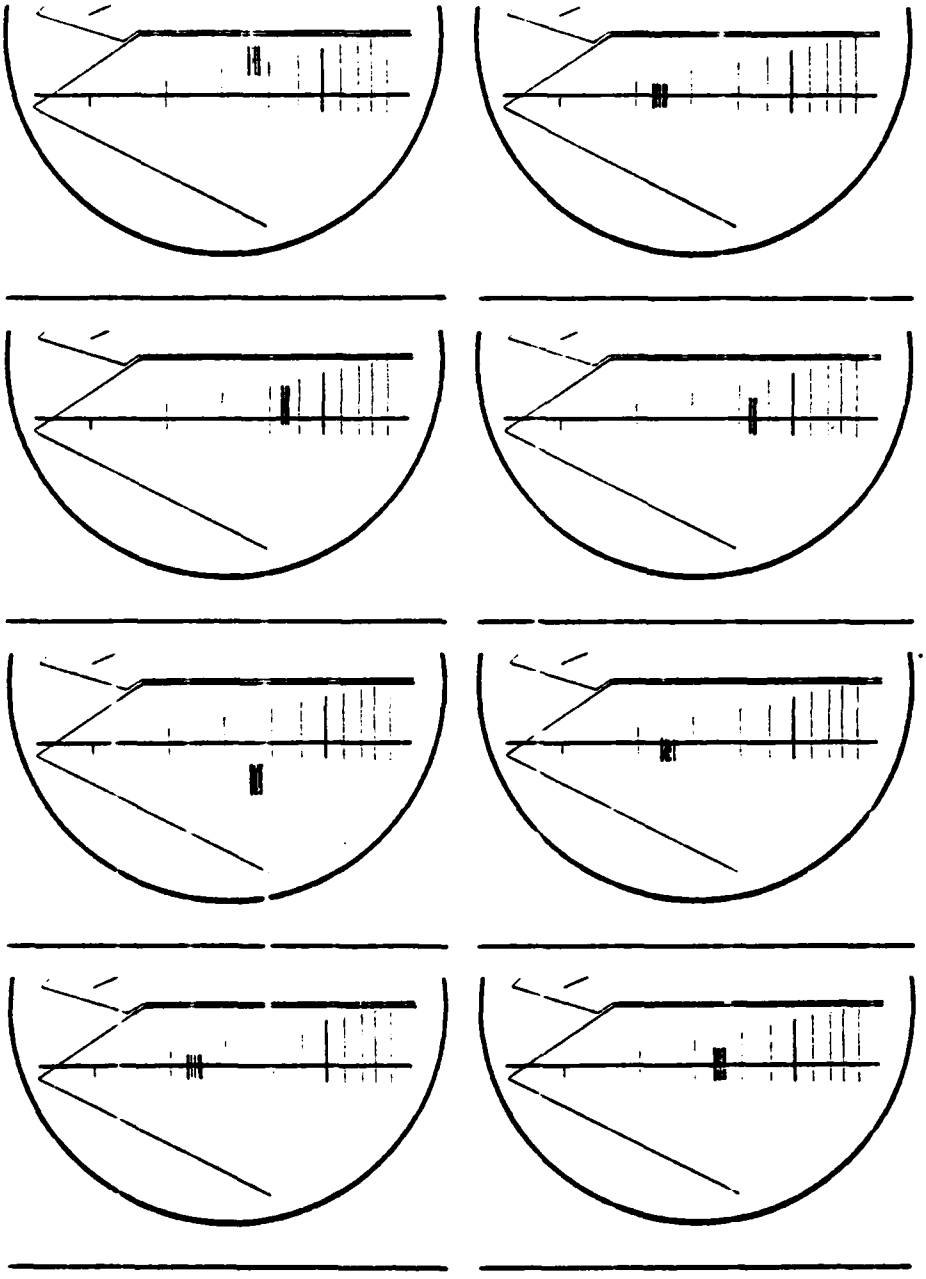


This picture shows the target zones and the correct course position information. Study it carefully! Don't turn the page until you have memorized the course position information.

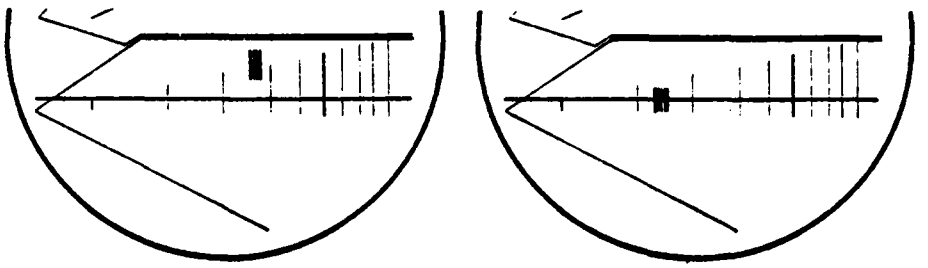


IMPORTANT: When deciding on the proper transmission, remember to take the pilot's perspective!

Practice issuing course position information for each example given below. Say the calls out loud to get used to them. Also write the answers under the pictures so you can check them when you turn the page.

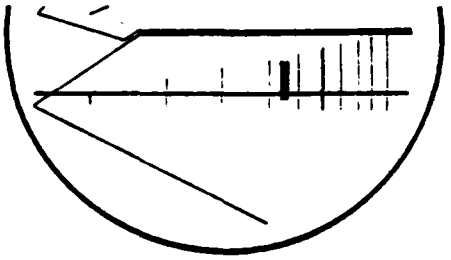


Here are the answers. Check to make sure your responses were correct.

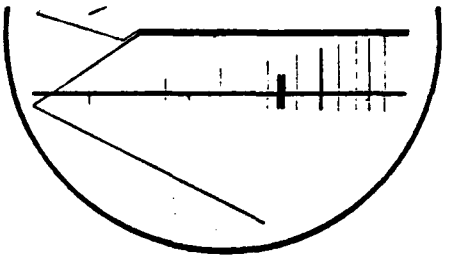


WELL RIGHT OF COURSE....

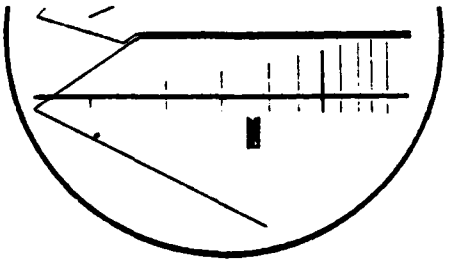
ON COURSE....



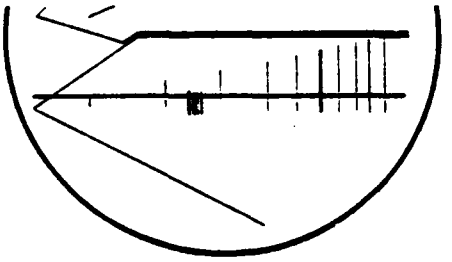
RIGHT OF COURSE....



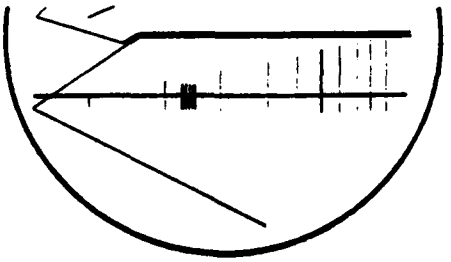
SLIGHTLY RIGHT OF COURSE....



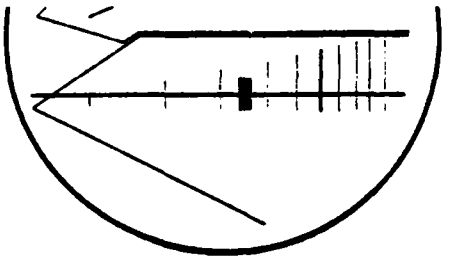
WELL LEFT OF COURSE....



LEFT OF COURSE....



SLIGHTLY LEFT OF COURSE....



ON COURSE....

Do you see how important it is to take the pilot's perspective when you are deciding whether the aircraft is right or left of course? You should learn to automatically think "right" when the target is above the azimuth cursor and "left" when it is below.

You are probably asking, what are the guidelines for issuing course position information? First, remember that these calls are filler transmissions. They do not cause the pilot to turn. If you feel that safety demands an immediate turn, give it without wasting any time! Usually, however, you will find you have plenty of time to give course position information. It is best to give it just before a corrective turn to give the pilot an idea of what you are trying to accomplish when you give the turn.

As you learned before, if the target is moving parallel to the centerline in zones 1 or 2, no turns are needed. Nevertheless you should inform the pilot of his or her course position at frequent intervals.

Any time you find it difficult to judge course position because the target is between zones, call the course position which is closer to the on course zone. That is, if the target is between "slightly right of course" and "right of course," you would call it "slightly right of course."

THE LAW

FINAL APPROACH GUIDANCE

a. Issue course guidance, inform the aircraft when it is on course, and frequently inform the aircraft of any deviation from course. Phraseology: HEADING (heading). ON COURSE or SLIGHTLY/WELL LEFT/RIGHT OF COURSE.

3.2 COURSE TREND INFORMATION

There is only one course trend call you will use during training, that is "correcting." You may use it after a course position message whenever the target is moving toward the azimuth cursor. Generally it is used only after the left/right or well left/right transmissions.

If you issue the well left or well right of course calls, you must give a turn or say "correcting" within three seconds.

Why isn't there a trend message to use when the target is moving away from the centerline? Because if it is moving away, you should give the pilot a turn to bring the aircraft back onto course.

In order for the GCA-CTS pilot to understand this call, you must pause slightly before and after you say it. Thus you might say:

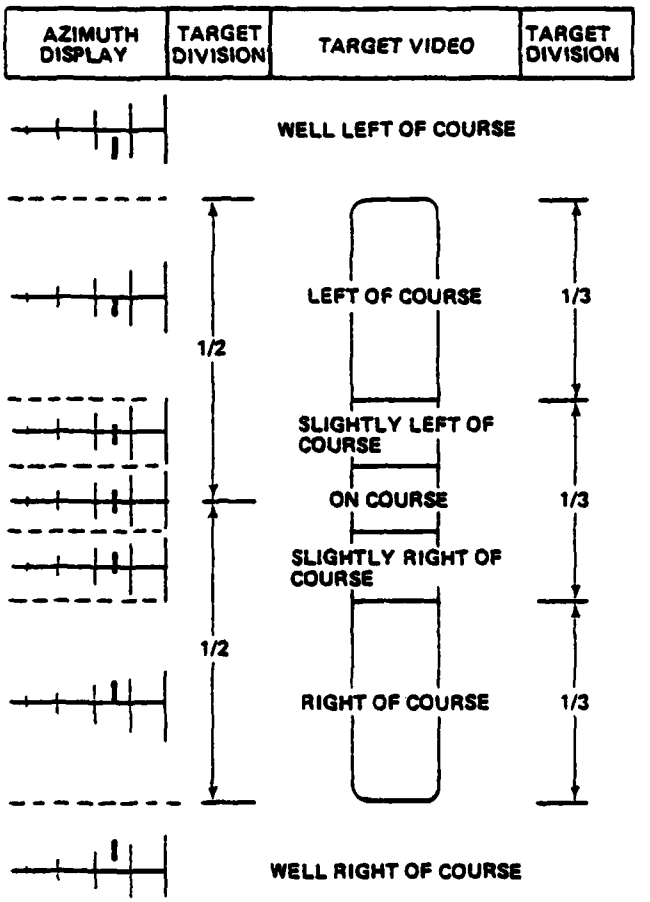
Well right of course (pause)

Correcting (pause)

COURSE POSITION AND TREND INFORMATION

SUMMARY

- Use this target division scheme to determine the correct course position calls.



- If there is sufficient time, issue course position prior to a turn.
- If no turn is needed, keep the pilot informed of course position.
- If in doubt about course position, choose the message closer to "on course."
- "Correcting" may be used after course position messages if the target is moving toward the centerline.
- When the "well" position message is given, it must be followed within three seconds by either a turn or "correcting."

GRADING

AZIMUTH POSITION AND TREND

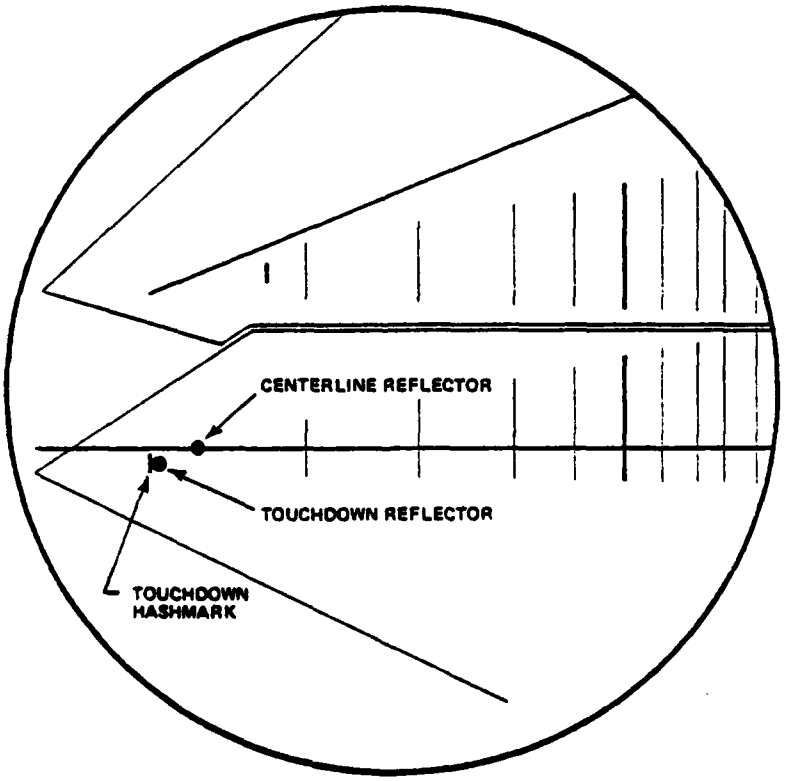
When you practice using azimuth position and trend, the system will check the following points.

	Weighting Factor Applied to Percentage Error	Total Possible Points
A. Position calls		
1. Position call correct	.5	
2. "Well" followed by a corrective turn within 3 seconds, or "correcting"	.25	
B. Trend calls		
"Correcting" must be used only when target is closing with centerline	.25	
		100

3.3 RANGE TO TOUCHDOWN

RANGE MARK ALIGNMENT. You have already learned that the vertical range marks or hashmarks on the azimuth and elevation displays are positioned at one mile intervals. These hashmarks are electronically generated and can get out of alignment just like the azimuth cursor can. Therefore you must also check range mark alignment when you take over your post.

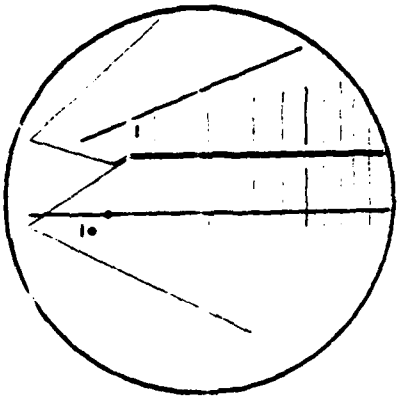
The steps are almost the same as those you followed for checking the azimuth alignment. First, ensure there is no aircraft on final before servoing. When you servo down, you will see the touchdown reflector off to the left of the centerline. There is a touchdown range mark which should touch the left edge of the radar return from the touchdown reflector.



If the touchdown hashmark is not touching the touchdown reflector, request alignment in the usual way, by depressing the ALIGN button in the GCA-CTS or by notifying your superior in the operational environment.

BEFORE TURNING THE PAGE

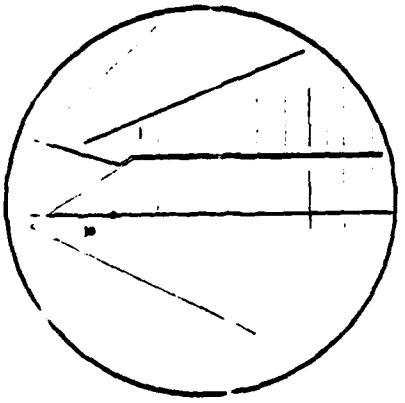
What would you do if you observed each of these radar displays?



In the GCA-CTS:_____

In the operational environment:_____

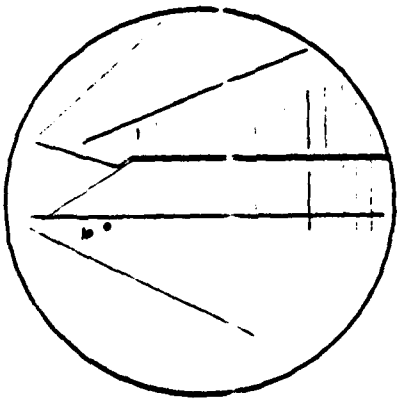
_____



In the GCA-CTS:_____

In the operational environment:_____

_____

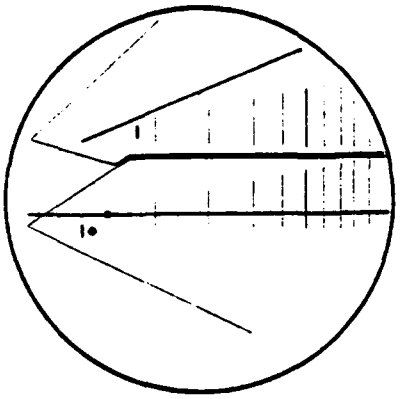


In the GCA-CTS:_____

In the operational environment:_____

_____

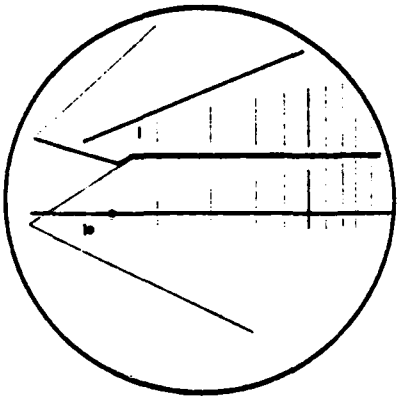
Here are the answers:



In the GCA-CTS: Depress ALIGN

In the operational environment: Notify Supervisor

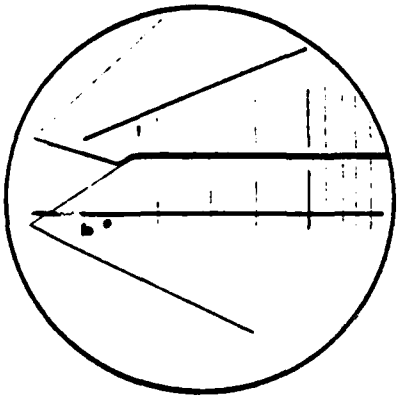
Why? Range mark alignment needed



In the GCA-CTS: Servo up and continue

In the operational environment: Servo up and continue

Why? No alignment needed



In the GCA-CTS: Depress ALIGN

In the operational environment: Notify Supervisor

Why? Azimuth cursor alignment needed

BEFORE TURNING THE PAGE

Stop for a moment. Were all of your answers correct? If not, were your mistakes due to carelessness? A radar controller cannot afford to be careless. You are responsible for human safety. Think about it.

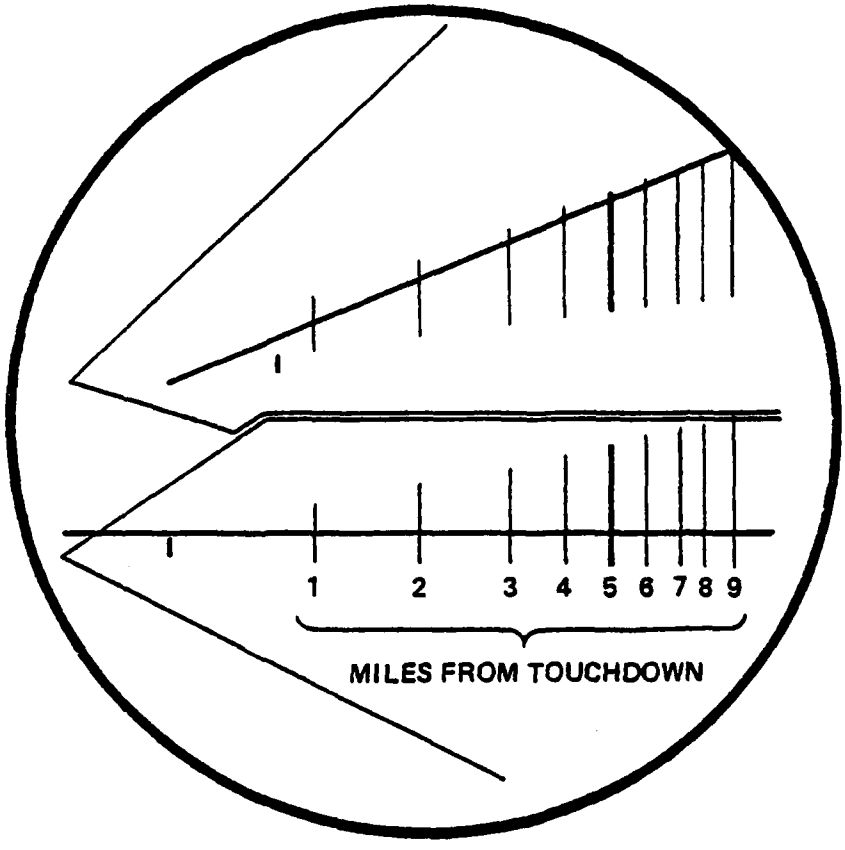
AZIMUTH AND RANGE ALIGNMENT CHECK PROCEDURE

SUMMARY

When you take your post and sign on:

1. Ensure there is no aircraft on final approach.
2. Servo down.
3. Observe the centerline reflector to determine whether or not it is bisected by the azimuth cursor.
4. Observe the touchdown reflector to determine whether or not its left edge is touching the touchdown hashmark.
5. If (a) the centerline reflector is not bisected by the azimuth cursor, or (b) if the touchdown range mark is not touching the left edge of the touchdown reflector, cause the radar to be aligned by:
    a. Notifying the supervisor, in the operational environment
    b. Pressing ALIGN, in the GCA-CTS.
6. Servo up until the one mile hashmark is bisected by the cursor on the elevation display.

ISSUING RANGE INFORMATION. Here is a closeup of the range marks on the PAR display.



Notice that the five-mile hashmark is brighter than the others. Notice also that the distance between one and two miles is much greater than the distance between seven and eight miles. This approximately logarithmic expansion or magnification of the scale at close range gives you a clear picture of the aircraft's exact position, and enables you to conduct a precision approach. That is what PAR is all about!

The rules for issuing mile mark calls are simple:

1. As the leading edge of the target return touches a mile mark, make a miles from touchdown transmission. Say:

   [digit] mile(s) from touchdown

2. Range calls prior to five miles are optional (three miles for short approach), but once any range is given, calls at each subsequent mile are mandatory.

3. If an emergency situation exists, the emergency transmission must take priority over the range call. An example would be a tower waveoff.

THE LAW

DISTANCE FROM TOUCHDOWN

Inform the aircraft of its distance from touchdown at least once each mile on final approach. Phraseology: (Number of miles) MILES FROM TOUCHDOWN.

BEFORE TURNING THE PAGE

Use the picture on the previous page and visualize an aircraft making a final approach. Say the mile mark advisories to yourself. You should become so familiar with the display that you recognize each milemark by name (number).

RANGE CALL PROCEDURES

SUMMARY

- When the leading edge of the target touches a mile mark, say, "[digit] mile(s) from touchdown."

- Range calls prior to five miles (three for short approach) are optional, but once any range is given, all further range calls must be given.

GRADING

RANGE INFORMATION

When you practice issuing the range calls, the system will check the following points.

		Weighting Factor Applied to Percentage Error	Total Possible Points
A.	All range calls must be made after the first one is made or 5 miles is reached, whichever comes first, unless superseded by an emergency	.6	
B.	The call must be made within ± 0.1 mile of the mark	.2	
C.	Correct miles must be used	.2	
			100

3.4 CLEARANCE PROCEDURE AND WIND INFORMATION

One of your most important duties as a GCA controller is to coordinate with the other members of the approach control team to ensure the safety of your aircraft. Since the tower controller has responsibility for traffic in the immediate vicinity of the runway, you must obtain clearance for your aircraft to land, make a touch-and-go or make a low approach. Then you must relay that clearance to the pilot, otherwise he or she will automatically execute a missed approach at one mile to get out of the way.

THE LAW

TOWER CLEARANCE

a. When an aircraft is on final approach to an airport served by a tower, obtain clearance to land, touch-and-go, or make low approach. Issue the clearance and the surface wind to the aircraft.

WIND INFORMATION

Issue surface wind when clearing aircraft for touch-and-go, stop-and-go, low approach, or the option.

LANDING CLEARANCE

Issue surface wind and landing clearance... Phraseology: WIND (surface wind direction and velocity). CLEARED TO LAND.

There are several different things that can happen when you request clearance. Let's start with the procedure you will use most of the time. It has four steps.

Step 1. When the target reaches three miles from touchdown, request clearance.

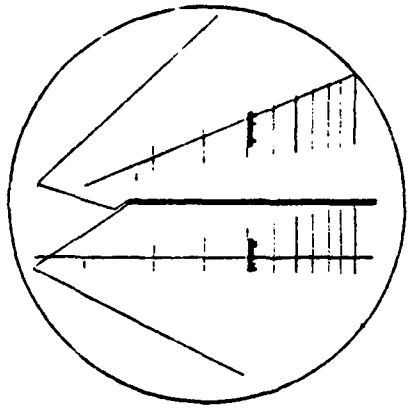
Step 2. Observe the response to the clearance request.

Step 3. If clearance is received, issue the wind information.

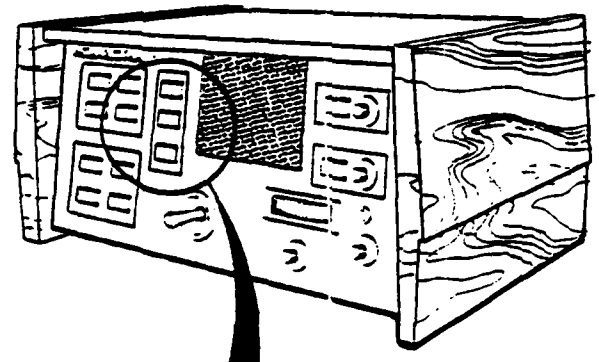
Step 4. If clearance was received and wind given, issue clearance.

Let's take these a step at a time.

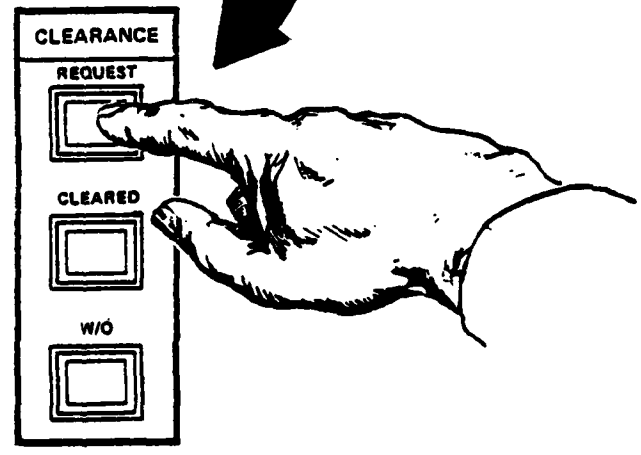
STEP 1. REQUEST CLEARANCE. In the GCA-CTS, and in most operational environments, clearance requests are made by pressing the white clearance request button. You must do this when the target touches the three-mile hashmark.



OBSERVE TARGET AT 3 MILES



DEPRESS "REQUEST"



The request light will turn white when you depress the button.

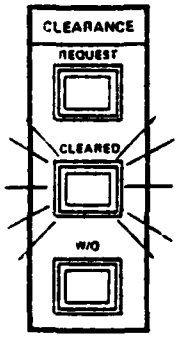
STEP 2. OBSERVE THE RESPONSE TO THE CLEARANCE REQUEST. Usually, clearance will be given. However, there are actually three possible responses to the clearance request. The procedures you follow depend upon the response from the tower. This table shows the possibilities.

Response	Meaning	Procedure to Follow
White REQUEST light goes out, green CLEARED light goes on	Aircraft is cleared for approach	A
After green light has been on, it goes out and red W/O light goes on with alarm	Clearance is cancelled, conduct a waveoff at once	B
White REQUEST light goes out	OK to continue approach, aircraft is not yet cleared	C

PROCEDURE A. CLEARANCE GIVEN

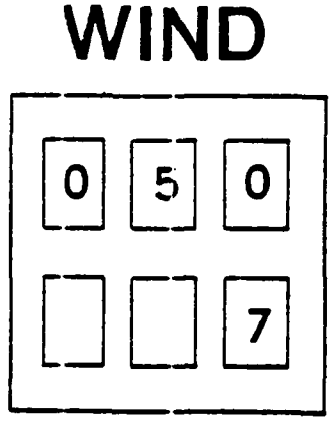
STEP 3. ISSUE WIND. Both the wind and clearance must be given prior to the aircraft reaching the one mile mark. Don't give the wind unless clearance has been received because some pilots interpret receiving wind as a clearance to land. To avoid any confusion, get the clearance to land first, then transmit the wind information.

When you see the green CLEARED light come on, give the wind information. The correct form is:

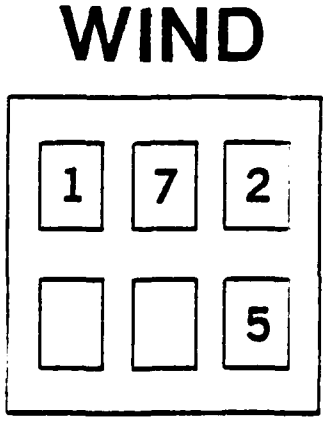


Wind (pause)
[digit] (pause)
[digit] (pause) } wind direction
[digit] (pause)
at (pause)
[speed] (pause)

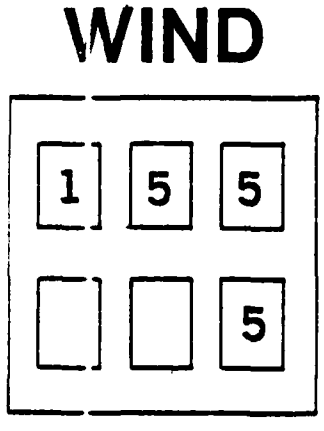
Wind information is shown in the upper left hand corner of the GCA-CTS display. Wind direction is always rounded to the nearest 10 degrees. Give the exact wind speed. Practice saying the wind messages for each of these cases. Be careful to insert the pauses!



Wind...zero...five...
zero...at. .seven



Wind...one...seven...
zero...at...five



Wind...one...six...
zero...at...five

PROCEDURE A. CLEARANCE GIVEN (continued)

STEP 4. RELAY CLEARANCE TO THE PILOT. After you have clearance from the tower (the green CLEARED light is on) and you have issued the wind information, relay the clearance to the pilot. The clearance you use depends upon the type of approach the aircraft is making. You must remember the type of approach that was specified in the handoff in order to issue the correct clearance information. If the pilot hears the wrong clearance, he or she may think it is for another aircraft and immediately execute a missed approach to get out of the way. The clearance information is:

For low approach:

Cleared for low approach (pause)

For touch-and-go:

Cleared for touch-and-go (pause)

For landing:

Cleared to land (pause)

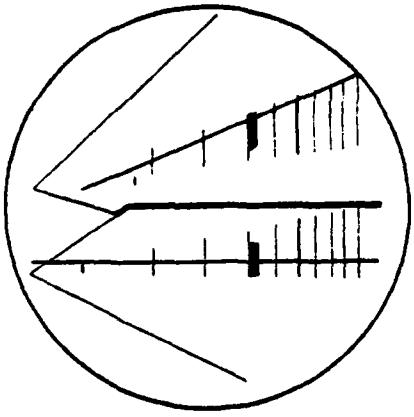
SAFETY. Getting the clearance from the tower and relaying it to the pilot is one of the most important aspects of your job because it directly affects the safety of your aircraft and of ground personnel. If you make an error which threatens the safety of the aircraft, the system will warn you by flashing "SAFETY ERROR" during replay with errors. The safety errors are shown on the blue grading sheets in the manual.

WIND/CLEARANCE PROCEDURE WHEN CLEARANCE IS GIVEN

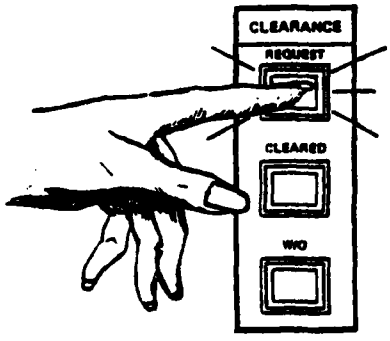
(PROCEDURE A)

SUMMARY

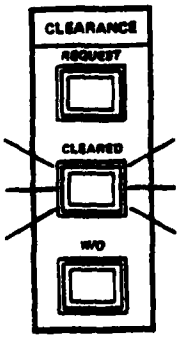
To summarize the procedure in the usual case, where clearance is given at the first request:



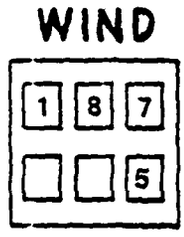
When you observe the target at three miles,



1. Depress clearance REQUEST button, white light comes on.



2. The tower gives clearance at the first request. After a few seconds, observe that the white light will go out and the green CLEARED light will come on.



3. Issue the wind information, for example:
"Wind...one...nine...zero...at...five"

4. Issue the appropriate clearance:
"Cleared for low approach"
"Cleared for touch-and-go"
or
"Cleared to land"

PROCEDURE B. WAVEOFF FROM TOWER

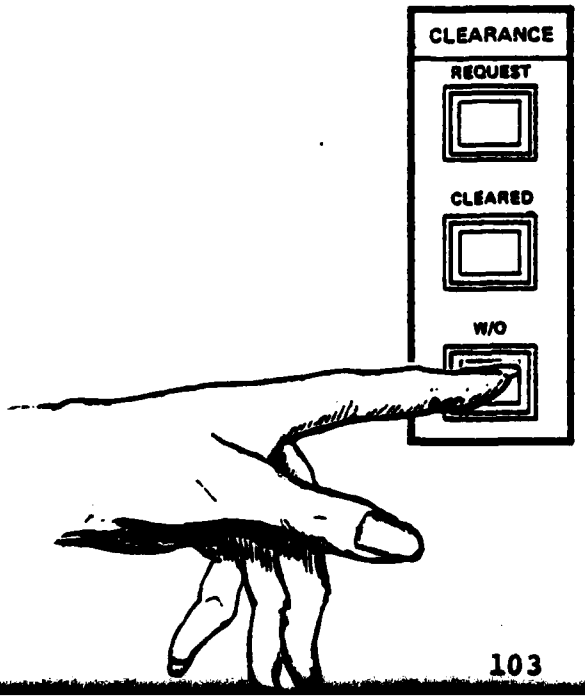
STEP 1. WAVEOFF LIGHT COMES ON, GIVE THE REASON AND WAVEOFF. After granting clearance the tower may light the W/O light and sound an alarm. When this happens, you must convey the waveoff to the pilot by giving the reason and a waveoff at once. You must always say this:

Tower clearance cancelled (pause)
Execute missed approach (pause)

For a full stop approach, technically this is sufficient. It is preferable in all cases, however, to add the missed approach procedure in case the pilot has forgotten it. For the GCA-CTS airfield say:

Climb and maintain one thousand five hundred (pause)
Turn right heading (pause)
Three (pause)
Zero (pause)
Zero (pause)

STEP 2. ACKNOWLEDGE THE WAVEOFF. As soon as possible after the waveoff light comes on, inform the tower that you are acting upon the waveoff. To do this depress the W/O button. The light and alarm will go out.



PROCEDURE B. WAVEOFF FROM TOWER (continued)

STEP 3. ENABLE COMMUNICATIONS WITH PATTERN CONTROLLER. Since you have just told the pilot to get out of the final approach corridor, you must coordinate his or her missed approach with the pattern controller so that control of the aircraft can be transferred as soon as the pattern controller picks up the pilot on radar. Depress ICS 5 to talk with the pattern controller.

STEP 4. HANDOFF TO PATTERN CONTROLLER. After a waveoff, the proper terminology for the handoff to the pattern controller is:

Missed approach (pause)
[Call sign] (pause)
[MAP position] miles (pause)
Button [#] (pause)

MAP (missed approach point) position is the range to the nearest .5 mile at which you gave the waveoff. Thus, if you transmitted a waveoff to Navy three one zero over 318.8 when the aircraft was at a range of about 1.5 miles, the handoff information would be, "Missed approach...Navy three one zero...one and one half miles...button two."

STEP 5. RELEASE RADIO FREQUENCY. Since the pattern controller cannot take over control of the aircraft until you release the radio frequency, you must do so immediately after giving the handoff. At this time you should deselect the appropriate XMIT button. Select the corresponding MON button.

STEP 6. MONITOR THE RADIO FREQUENCY. You must assure yourself that control of the aircraft has been taken by the pattern controller. Do this by depressing the appropriate MON button and listening until you hear the pattern controller tell the pilot "[Call sign], radar contact." If this call is not heard, you should repeat the handoff after 15 seconds.

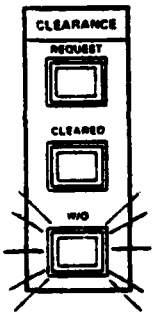
STEP 7. DESELECT MONITOR. Once the pattern controller has radar contact, deselect the MON button. ICS 5 should still be selected – the pattern controller will give you another handoff soon.

PROCEDURES FOR USE WHEN TOWER ISSUES A WAVEOFF

(PROCEDURE B)

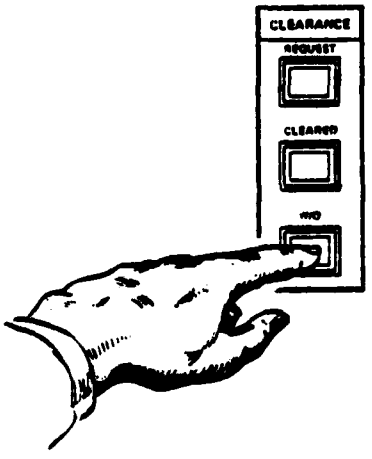
SUMMARY

This summary shows the sequence of steps to take whenever the red W/O light starts flashing. During training this will only happen after clearance has already been granted. Whenever this light comes on it means safety demands that you give a waveoff at once. The steps are:

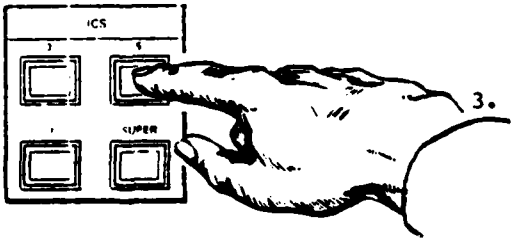


When you see the red W/O light begin to flash and hear the alarm:

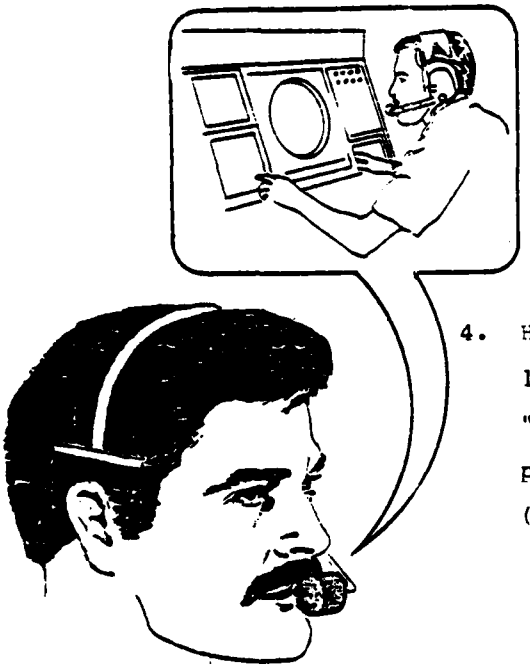
1. Conduct the waveoff by saying to the pilot: "Tower clearance cancelled...execute missed approach." For touch-and-go or low approaches, you must add the missed approach instructions. You may add them for full stop approaches: "Climb and maintain one thousand five hundred...turn right heading...three... zero...zero."



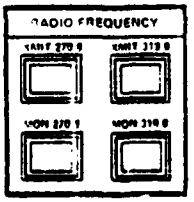
2. Acknowledge waveoff by depressing the W/O button



3. Depress ICS 5 to enable communications with the pattern controller



4. Hand the aircraft off to the pattern controller by saying,
"Missed approach...[call sign]...[map position] miles...button [#]"
(Don't key the mike on this one!)



5. Deselect the XMIT button releasing the radio frequency
6. Select the MON button and listen for the pattern controller to tell the pilot
"[Call sign], radar contact"
7. Deselect the monitor button

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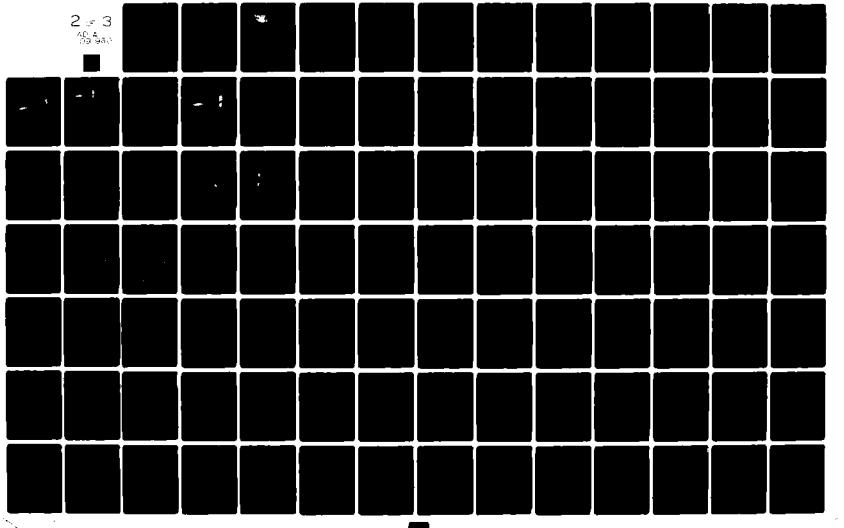
GROUND CONTROLLED APPROACH CONTROLLER TRAINING SYSTEM (GCA-CTS)--ETC(U)
JUN 80 M HICKLIN N61339-77-C-0162
UNCLASSIFIED NAVTRAEQUIPC-77-C-0162-4 NL



PROCEDURE C. CLEARANCE NOT GIVEN

STEP 1. CLEARANCE NOT GIVEN, MAKE A SECOND REQUEST. Occasionally the tower will not give clearance the first time you request it. This can happen for a variety of reasons, and it means that the approach should be continued and clearance requested again at two miles. If you see the white REQUEST light go out, but do not see the green CLEARED light come on, it means you can continue and will have to make your request again. Do so at two miles by depressing the REQUEST button again.

STEP 2. OBSERVE THE RESPONSE TO THE SECOND REQUEST. The same things can happen after the second clearance request as after the first: the tower can give the clearance, not give it, or clear then waveoff. If clearance is given, follow procedure A, steps 3 and 4 (issue wind and clearance information). Any time the waveoff light comes on, follow procedure B, (conduct a waveoff). If clearance is not received by the time the aircraft reaches about 1.3 miles, you must wave it off. The procedure is similar to procedure B, as follows.

STEP 3. GIVE THE REASON AND WAVEOFF. Inform the pilot that clearance was not received and give the waveoff. Say:

> Tower clearance not received (pause)
> Execute missed approach (pause)

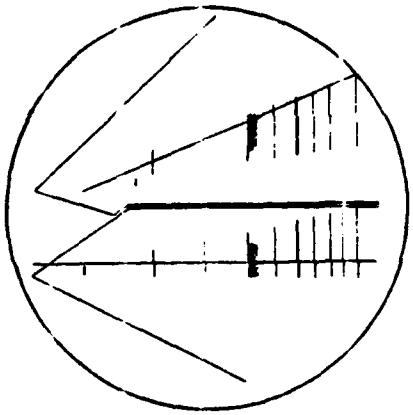
Again, this is sufficient for a full stop approach. For other approaches, you must give the missed approach instructions:

> Climb and maintain one thousand five hundred (pause)
> Turn right heading (pause)
> Three (pause)
> Zero (pause)
> Zero (pause)

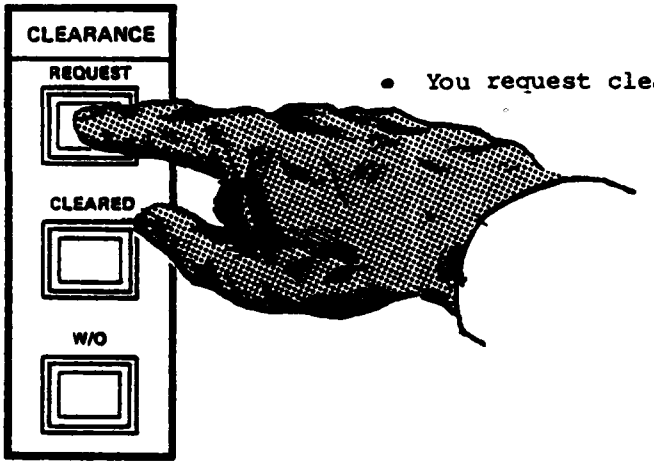
Finally, hand the aircraft off to the pattern controller as in procedure B, steps 3-7.

Here are some practice situations. Imagine yourself in each of the situations and determine what response you should make. If there is a transmission that is needed, practice saying it. Make sure you put the pauses in the right place! The answers follow.

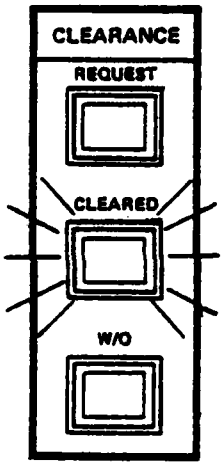
Question 1. The handoff was "Position 4...Navy three one zero, P3, full stop, button 1."



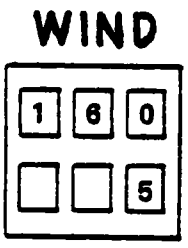
- you observe the aircraft at 3 miles



- You request clearance



- 10 seconds later the green CLEARED light comes on



- What are the next two transmissions you should give the pilot (in order)?

_____

_____

- What would they be if this aircraft were making a low approach?

_____

_____

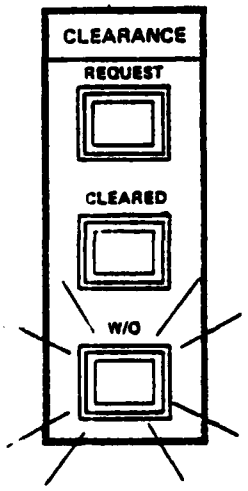
For the full stop approach, the transmissions are:

Wind...one...six...zero...at...five...
Cleared to land.

For the low approach:

Wind...one...six...zero...at...five...
Cleared for low approach.

Question 2. Suppose the handoff was, "Position 4...Navy three one zero, P3, full stop, button 2." You have requested clearance and received it. Then at 1.5 miles:



The red W/O light comes on. Visualize the procedure you must follow. List the 7 steps as you mentally perform them.

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____

Did you remember the sequence?

1. Say "Tower clearance cancelled...execute missed approach." You may add "Climb and maintain one thousand five hundred...turn right heading... three...zero...zero."
2. Depress the W/O button.
3. Depress ICS 5.
4. Say to pattern controller "Missed approach...Navy three one zero...one and one half miles...button 2."
5. Deselect XMIT 318.8.
6. Select MON 318.8, wait for the pattern controller to say "Navy three one zero, radar contact."
7. Deselect MON 318.8.

Go over this procedure until you are sure you have it down. In an emergency, you won't have time to refer to your notes!

Question 3. Suppose an aircraft coming in for a low approach has reached three miles and you requested clearance. If the white REQUEST light goes out but the CLEARED light doesn't come on, what do you do next?

The answer is, when the aircraft reaches two miles, press the clearance REQUEST button again.

QUESTION 4. Let's take the above situation further. Suppose the aircraft has reached 1.8 miles from touchdown. Suppose the green CLEARED light comes on. What do you say?

_____

_____

What would you do if clearance was not received by the time the aircraft reached about 1.3 miles from touchdown?

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____

IF the CLEARED light came on, say,

"Wind...[digit]...[digit]...[digit]...at...[speed]...
Cleared for low approach"

If the CLEARED light never came on, at about 1.3 miles do the following:

1. Say "Tower clearance not received...execute missed approach...climb and maintain one thousand five hundred...turn right heading... three...zero...zero..." to the pilot.
2. Depress ICS 5.
3. Say to the pattern controller, "Missed approach...[call sign]...one mile...button [#]."
4. Deselect XMIT button.
5. Select MON button, wait for pattern to say "[Call sign], radar contact."
6. Deselect MON button.

Now, invent some practice situations to test yourself. Visualize the procedures. Practice saying the transmissions.

CLEARANCE-RELATED PROCEDURES

SUMMARY

1. When the target reaches three miles from touchdown, depress clearance REQUEST.
2. Observe the clearance request response, select the appropriate procedure.

If CLEARED light comes on (Procedure A):

3. Issue wind information, "wind... [digit]...[digit]...[digit]... at...[speed]." Round direction to the nearest 10 degrees.
4. Issue one of these clearance messages,
   "Cleared for low approach"
   "Cleared for touch-and-go"
   "Cleared to land."

If W/O light comes on or if clearance is given, then cancelled (Procedure B):

1. Say "Tower clearance cancelled... execute missed approach." For low approach and touch-and-go, add, "Climb and maintain one thousand five hundred...turn right heading... three...zero...zero."
2. Depress W/O button.
3. Depress ICS 5.
4. Say to pattern controller, "Missed approach...[call sign]...[map position]...button [#]."
5. Deselect XMIT button.
6. Select MON, wait for pattern controller to say "[Call sign] radar contact."
7. Deselect MON button.

If clearance is not given (Procedure C):

1. Request clearance again at two miles.
2. If clearance is received, follow steps 3 and 4 of Procedure A.
3. If clearance is not received by about 1.3 miles, say "Tower clearance not received...execute missed approach." For low approach and touch-and-go, add "Climb and maintain one thousand five hundred...turn right heading... three...zero...zero." Then follow Procedure B, steps 3-7.

GRADING

CLEARANCE PROCEDURES

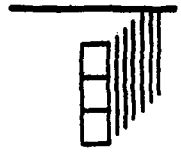
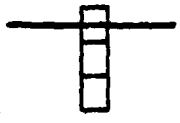
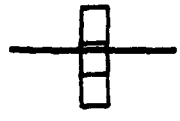
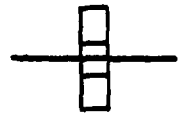
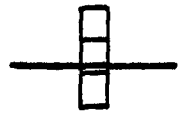
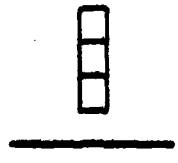
	Partial Credit	Total Possible Points
A. Clearance request		
1. Initial clearance request is made after 3.1 miles	10	
2. Initial clearance request is made prior to or at 2.9 miles	30	
3. If clearance is not received, a second request is posted between 2.1 and 1.9 miles; else no further request	10	
B. Issuance of clearance when received from tower		
1. Correct wind information is given	10	
2. Wind is issued after clearance is received from tower	5	
3. Correct clearance issued after it is received from the tower*	5	
4. Correct clearance is issued after wind	10	
5. Clearance must be issued prior to 1 mile	20	
C. Clearance problems leading to a waveoff		
1. If clearance is not received		
a. Issue reason and waveoff prior to 1.3 miles*	35	
b. Use proper missed approach instruction	15	
or		
2. If waveoff is given or clearance is cancelled		
a. Issue reason and waveoff within 2 seconds of receipt of cancellation*	35	
b. Use proper missed approach instruction	15	
		100

*Safety error

LEVEL THREE

RADIO TERMINOLOGY SUMMARY

(All transmissions are over the radio frequency unless otherwise noted)

Event		PAR Controller Response	Purpose
Target left and not touching azimuth cursor, moving toward cursor.		"Well left of course... correcting"	To convey course position and trend information
Target left and not touching azimuth cursor, moving away from cursor		"Well left of course... turn right heading... [digit]...[digit]... [digit]"	To convey a course correction
Azimuth cursor intersecting right 1/3 of target		"Left of course"	To convey course position information
Azimuth cursor intersecting right half of middle 1/3 of target		"Slightly left of course"	
Azimuth cursor bisecting target		"On course"	
Azimuth cursor intersecting left half of middle 1/3 of target		"Slightly right of course"	
Azimuth cursor intersecting left 1/3 of target		"Right of course"	
Target right and not touching azimuth cursor		"Well right of course"	

RADIO TERMINOLOGY SUMMARY (continued)

Event	PAR Controller Response	Purpose
Leading edge of the target touches a hashmark	"[digit] mile(s) from touchdown"	To convey range to touchdown
Green CLEARED light comes on	"Wind...[digit]...[digit]... [digit]...at...[speed]"	To relay wind information
Clearance has been received and wind has been given	"Cleared for [type of approach]"	To relay clearance
W/O light comes on or clearance not received by 1.2 miles	For full stop approach, "Tower clearance [cancelled, not received]...execute missed approach." For other approaches add, "Climb and maintain one thousand five hundred...turn right heading...three...zero... zero..."	Waveoff
Waveoff has been given to pilot	Over ICS 5, "Missed approach... [call sign]...[map position] miles...button [#]"	Handoff to pattern controller

LEVEL FOUR

ELEVATION CONTROL PROCEDURES

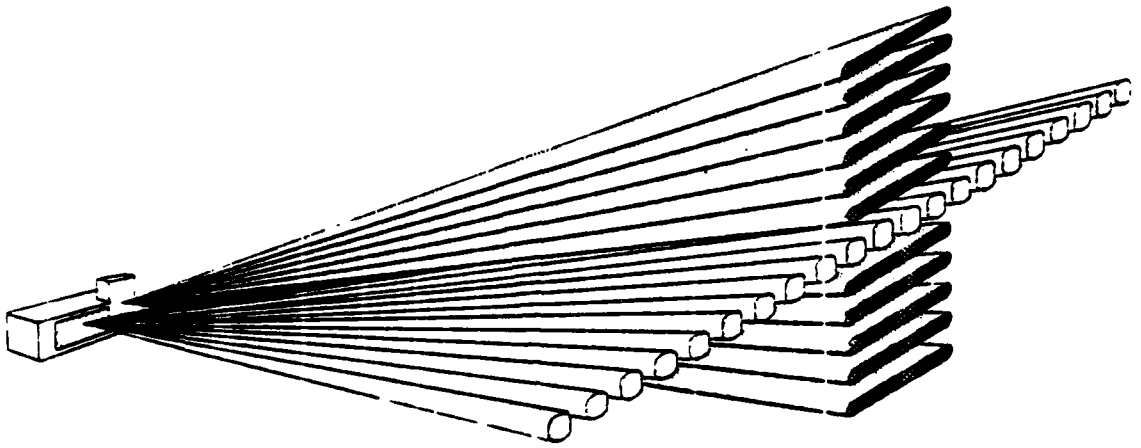
4.0 INTRODUCTION

In this level you will learn to use the upper portion of your PAR indicator to give glidepath information to the pilot. You will learn:

- To ensure the glidepath cursor is properly aligned
- To give the approaching glidepath, begin descent, and at decision height transmissions
- To give glidepath position and trend information on final.

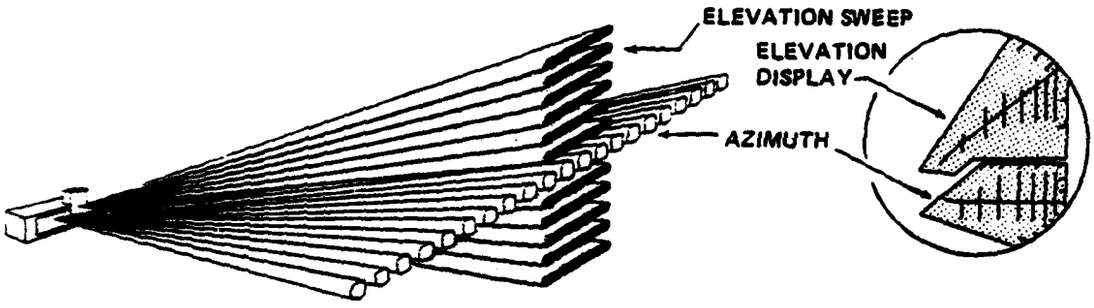
4.1 REVIEW OF ELEVATION RADAR CONCEPTS

In Level Two it was necessary to study the operation of the azimuth radar before trying to understand servoing and azimuth control procedures. Likewise in this level it will be necessary to study the operation of the elevation radar and then go on to study the proper way to use it. Let's go back to this picture you've seen before.

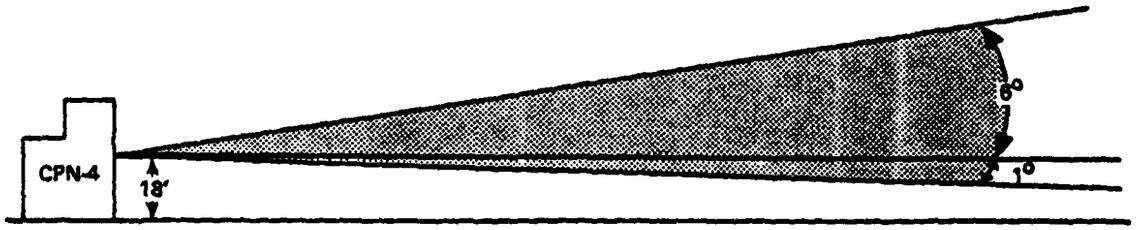


BEFORE TURNING THE PAGE

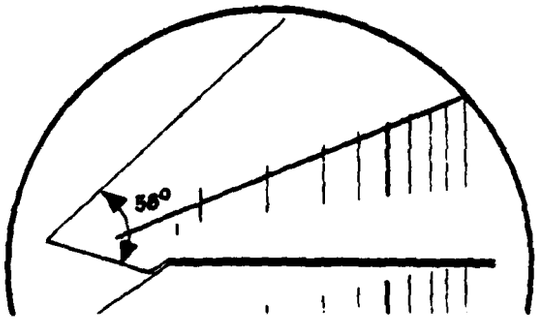
Which is the elevation sweep in the drawing? Visualize the PAR indicator. Where is the elevation information displayed?

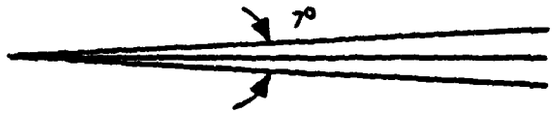


This side view shows the geometry of the elevation radar.

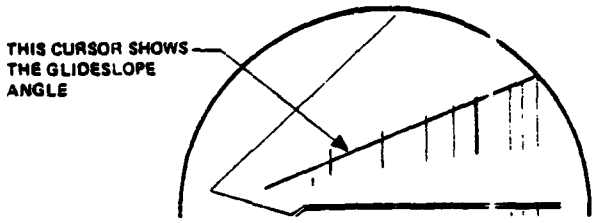


It is important to <u>really</u> understand this geometry so that you can understand the information presented on your PAR indicator. In this closeup of the elevation display, notice that the electronically generated cursor corresponds to the 3° glideslope at the GCA-CTS airfield. Notice also that, like the azimuth display, angles are expanded. If this were not done, your indicator would look like the picture on the right.

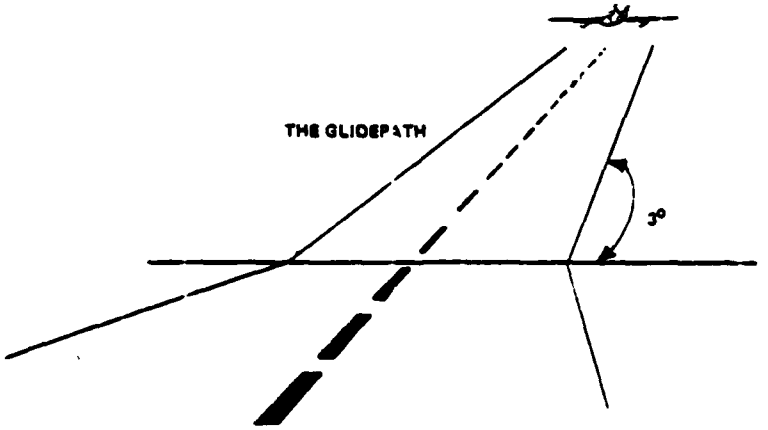




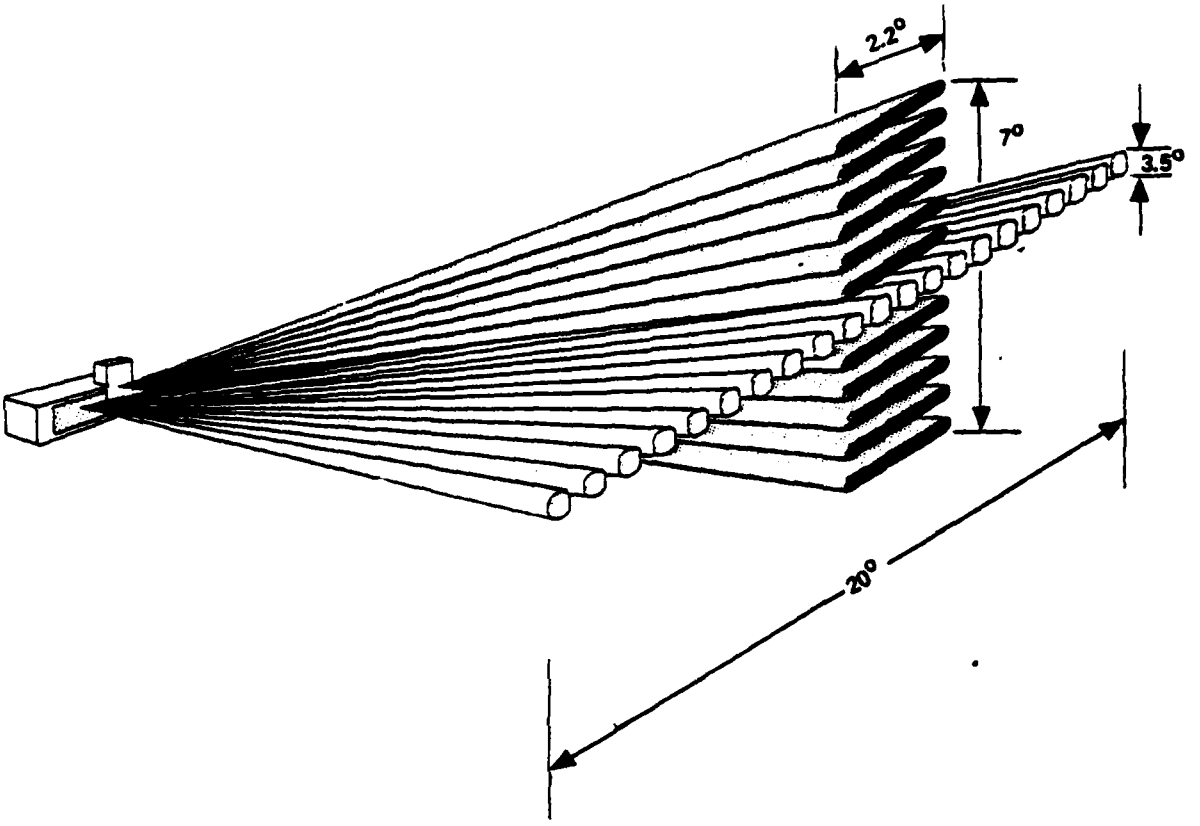
You have come across the two words "glideslope" and "glidepath" several times now. As a professional air traffic control person, you will always want to use correct terminology. There is a difference between these terms and you should use the words properly. The glideslope is the ideal angle of approach established for a particular installation. The glideslope is a slope or angle which will provide a safe approach to the runway. At this installation, the glideslope is 3°, although other installations sometimes use 2 1/2° or 4° depending on the descent gradients. We call the cursor on the elevation display a glideslope cursor since it shows this angle.



The glidepath is the path we want the aircraft to follow during its descent. It could be said that the glidepath is the position in relation to the glideslope. This is the term that the final controller uses in transmissions to the pilot. Think of the glidepath as an imaginary ramp down which we want the aircraft to fly. This imaginary ramp is built at the glideslope angle, and touches the ground at landing threshold.



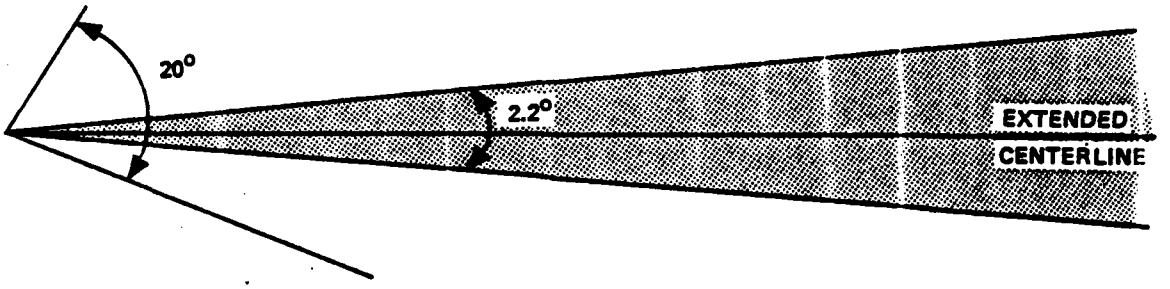
To return to the elevation radar scan, you will notice it is relatively narrow when compared to the azimuth scan.



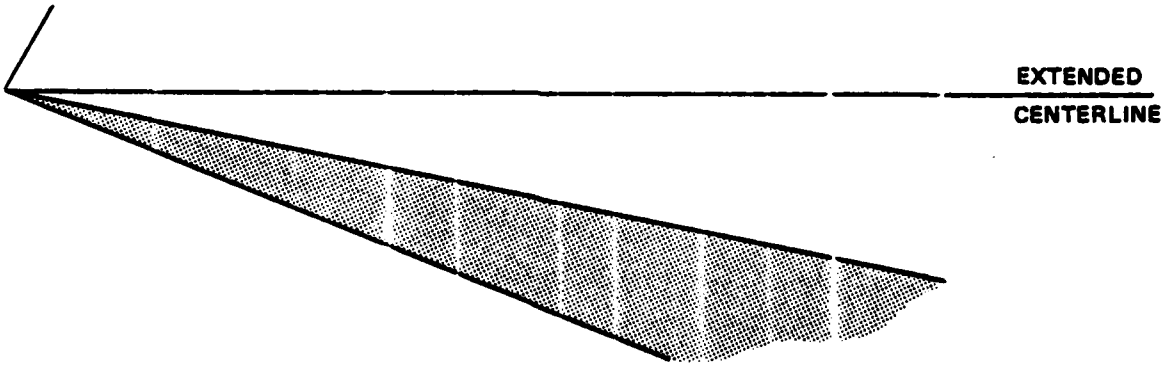
BEFORE TURNING THE PAGE

Visualize the operation of the elevation servo. Which way does it move? What happens to the sweep area as it moves?

The elevation radar can be servoed right and left. Here, in this top view looking down on both radars, you can see the elevation radar scan (shaded) in its normal position. The unshaded portion shows the azimuth radar. (The angles have been exaggerated, but the proportions are correct.)



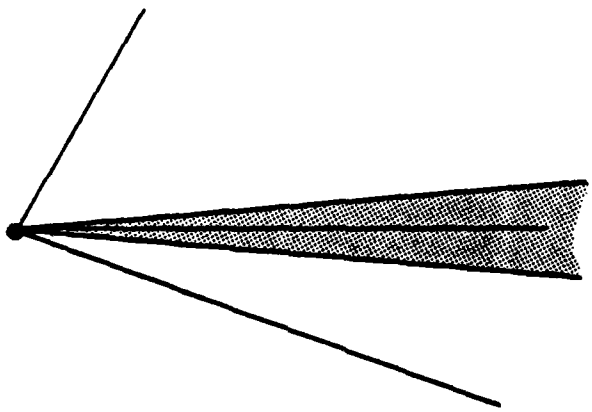
Here the elevation radar is servoed left.

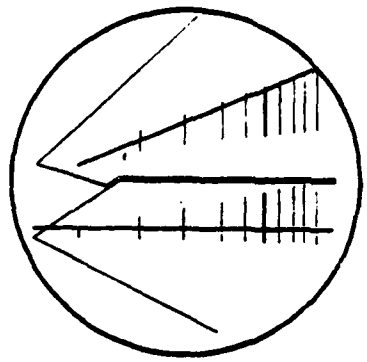


BEFORE TURNING THE PAGE

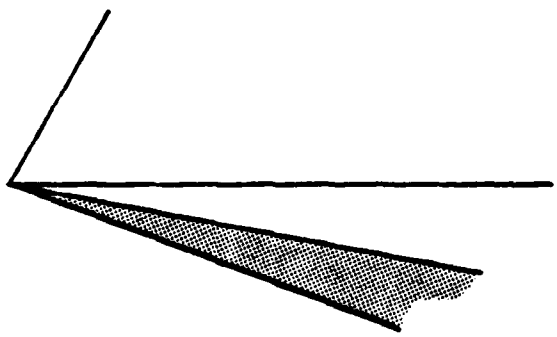
Sketch the PAR display for each of these cases. Check your drawings with the ones on the next page.

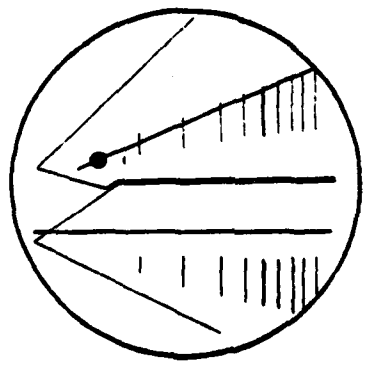
When the elevation radar is centered, the indicator looks like this. Notice that the one-mile hashmark on the azimuth display is bisected.



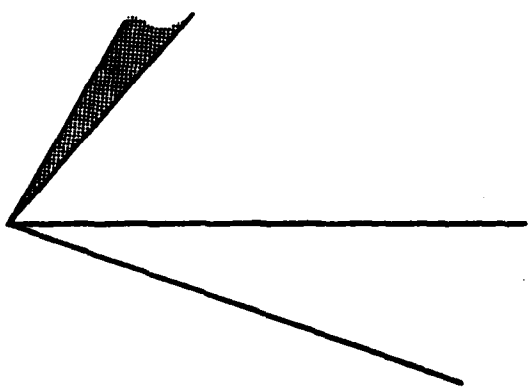


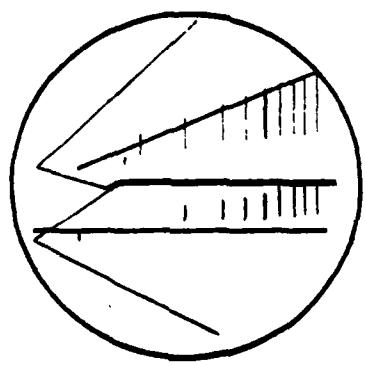
Here the elevation radar is servoed left.



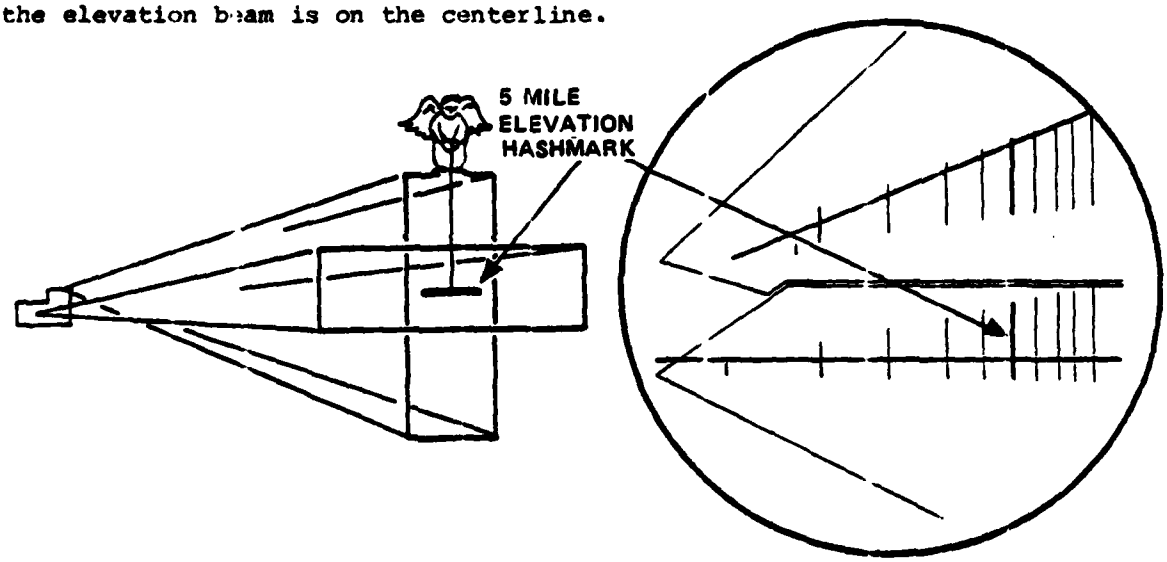


Here it is servoed right.

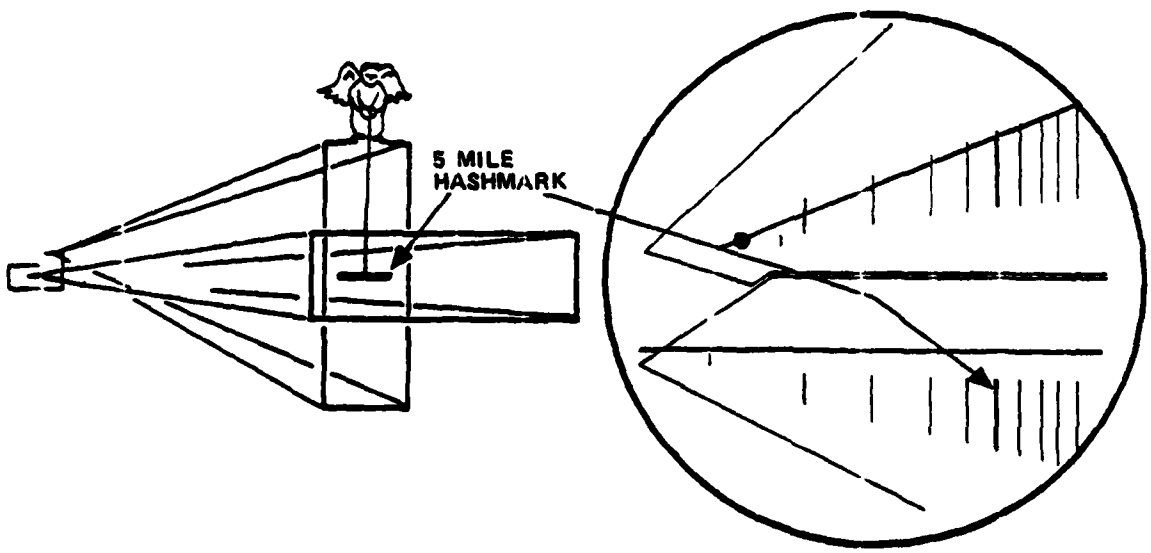




Do you see why it makes sense that the hashmarks on the azimuth display move with the elevation servo? The azimuth indicator shows left and right movement. This is the reason the elevation's left and right movement shows up on the azimuth display. The pictures below may help you understand it. If you think of the hashmarks as reflectors held in the elevation beam by an imaginary creature who rides on top of the beam, it should become clear. Here the elevation beam is on the centerline.



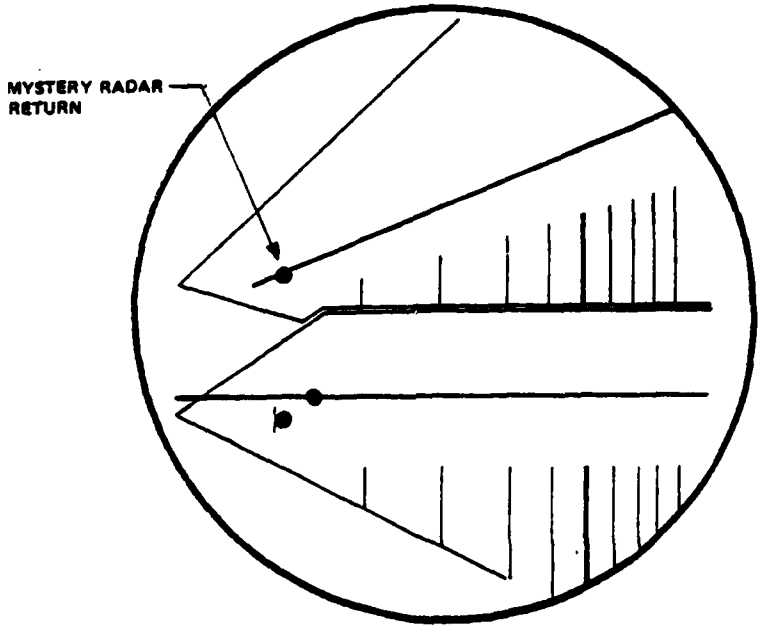
Here it is servoed left.



Of course the hashmarks are actually generated electronically on your PAR indicator. (You may want to compare these pictures to the ones on page 2-7.)

4.2 CHECKING ELEVATION ALIGNMENT

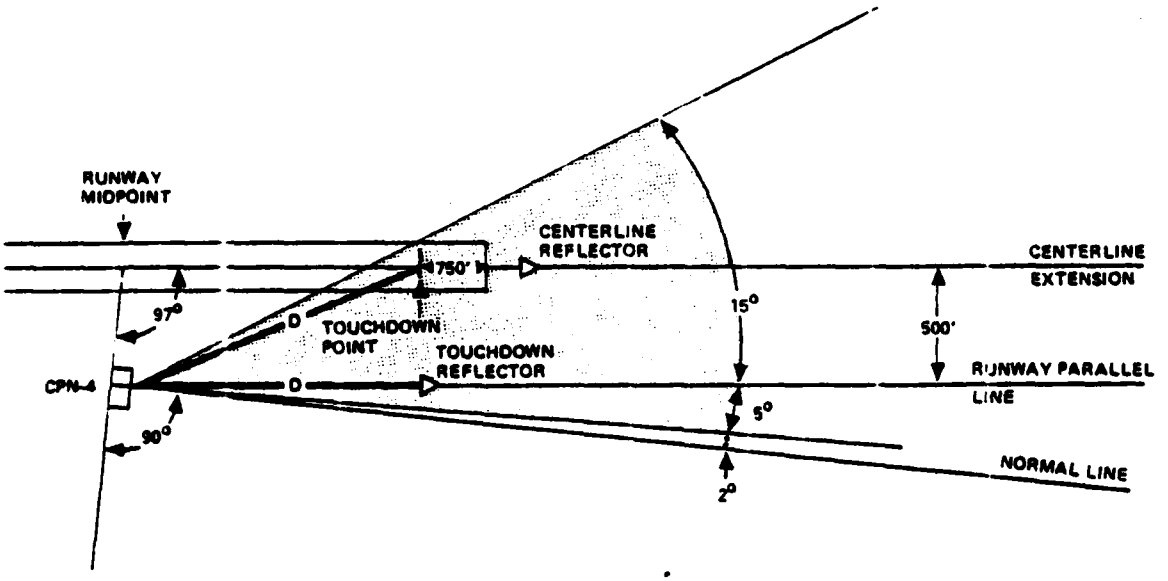
The last alignment checking procedure you must learn is that for the elevation display. The procedure is similar to the procedures you have already learned. Did you notice in the pictures on the last few pages that when the elevation radar was servoed left that there was a bright spot on the elevation display? Look again. Here we are servoed left and down.



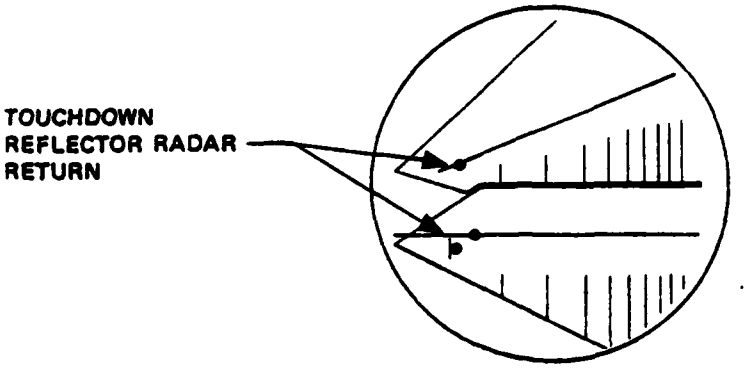
BEFORE TURNING THE PAGE

Try to figure out what it is that the elevation scan is picking up when it is servoed left. Hint: The geometry shown on page 2-3 may help.

Did you get it? The mystery spot is the radar return from the touchdown reflector. This reflector stands at a height of 18 feet. Obviously it can't be in the center of the runway! This picture shows that it is off to the left of the runway. That is the reason why it only shows up on the elevation display when you servo left.

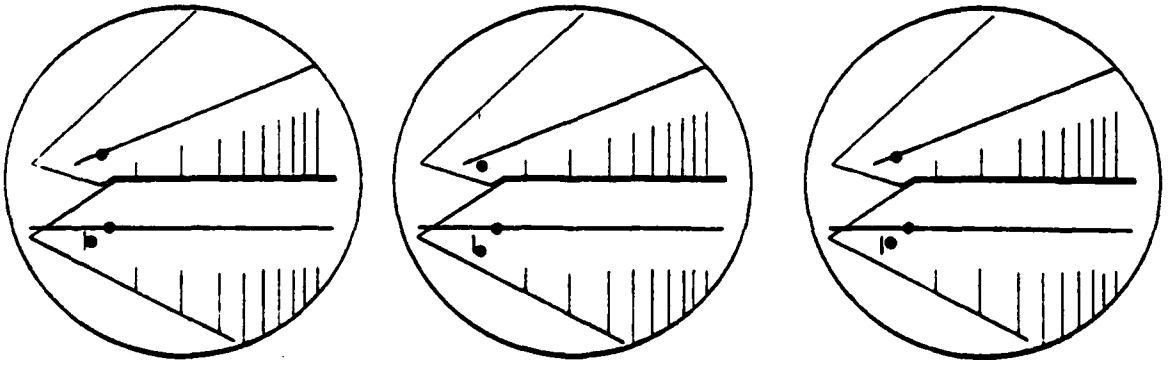


Notice that it is the same touchdown reflector you see on the azimuth display when you servo down.

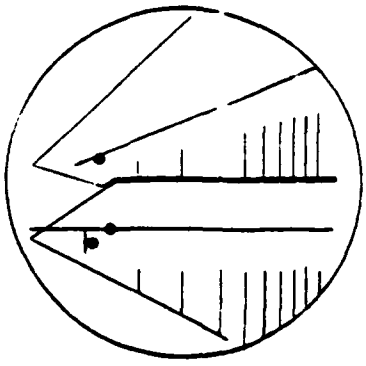


You used this reflector to check range mark alignment. It is also used to check the alignment of the elevation cursor. This cursor is properly aligned when it intersects the top one third of the touchdown reflector.

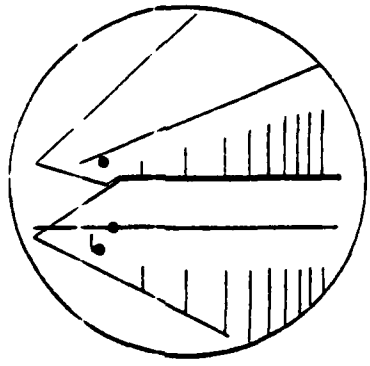
Try these problems. Indicate which ones require alignment and the reason.



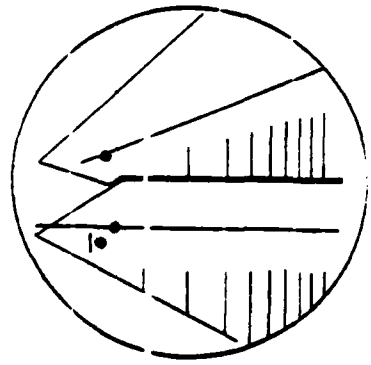
Here are the answers.



NO ALIGNMENT NEEDED



ELEVATION ALIGNMENT NEEDED



RANGE MARK ALIGNMENT NEEDED

BEFORE TURNING THE PAGE

Go through the whole alignment procedure in your mind. You add the elevation alignment check to what you already know. Check yourself against the summary given on the next page.

COMPLETE PAR ALIGNMENT CHECK PROCEDURE

SUMMARY

When you take your post and sign on:

1. Ensure there is no aircraft on final approach.
2. Servo down.
3. Servo left.
4. Observe the centerline reflector to determine whether or not it is bisected by the azimuth cursor.
5. Observe the touchdown reflector to determine whether or not its left edge is touching the touchdown hashmark.
6. Observe the touchdown reflector on the elevation display to determine whether or not the top one third is intersected by the glideslope cursor.
7. If (a) the centerline reflector is not bisected by the azimuth cursor, or (b) if the touchdown range mark *is not touching* the left edge of the touchdown reflector, or (c) if the top one third of the touchdown reflector is not intersected by the elevation cursor, cause the radar to be aligned by:

   a. Notifying the supervisor in the operational environment

   b. Pressing ALIGN in the GCA-CTS

8. Servo up until the one-mile hashmark is bisected by the cursor on the elevation display.
9. Servo right until the one-mile hashmark is bisected by the cursor on the azimuth display.

GRADING

ALIGNMENT CHECK

Now that you have learned the entire procedure, the system will grade it. Remember to check alignment every time you sign on. (Of course you must wait until there is no aircraft on final.) This is what the system will check:

	Partial Credit	Total Possible Points
A. Alignment check preparation		
1. Azimuth: servo down until centerline reflector appears	10	
2. Elevation and range: servo left until touchdown reflector appears	10	
B. Select ALIGN if alignment of		
1. azimuth	20	
2. elevation	20	
3. range	20	
is needed; else not		
C. Reposition antennas		
1. servo up until one-mile mark is bisected by glideslope cursor	10	
2. servo right until the one-mile mark is bisected by azimuth cursor	10	
		100

A, B, and C must be performed sequentially, or no credit is given.

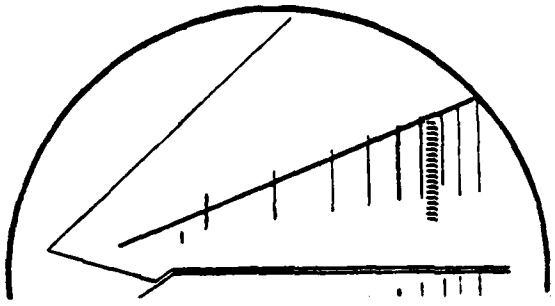
4.3 APPROACHING GLIDEPATH

As a PAR controller, you must not only keep your aircraft on course but also keep it on glidepath. This means you must tell the pilot when to begin descent, then give position and trend so that a safe rate of descent will be maintained. In general, glidepath control involves these procedures:

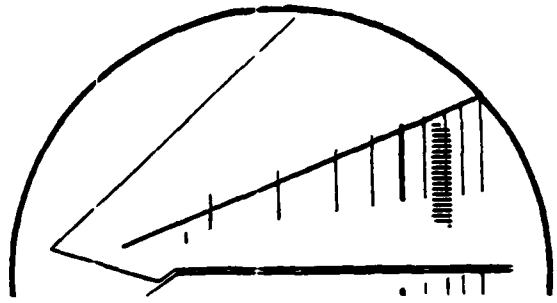
- Warn the pilot to be ready to start descending ("approaching glidepath").
- Tell the pilot to begin descent ("begin descent").
- Issue glidepath position and trend.
- Inform the pilot when the minimum descent altitude has been reached ("at decision height").

Let's start at the beginning with the approaching glidepath transmission. This transmission is like the "get set" part of "on your mark, ...get set,... GO!" It tells the pilot that the aircraft is about to intersect the glideslope and that he or she should be prepared to begin descent within 10 to 30 seconds.

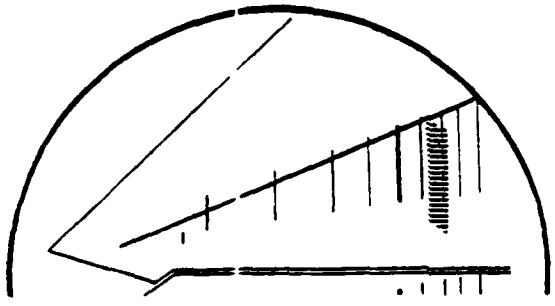
The pictures below show the range (shaded) in which approaching glidepath should be spoken. Obviously this range is different for aircraft having different approach speeds.



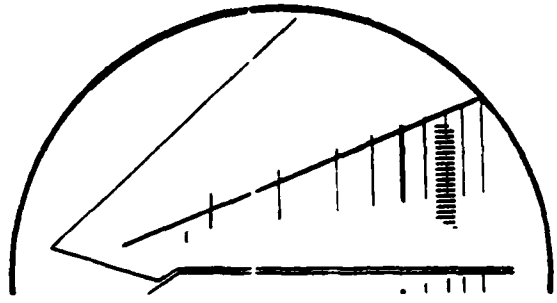
U-21
(98 kts)



A6
(115 kts)



P3
(130 kts)



T38
(156 kts)

Visualize the target entering the shaded area and practice giving the transmission:

Call sign (pause)
approaching glidepath (pause)
over (pause)

THE LAW

GLIDEPATH NOTIFICATION

Inform the aircraft when it is approaching glidepath (approximately 10 to 30 seconds before final descent).

Phraseology: APPROACHING GLIDEPATH.

4.4 DO NOT ACKNOWLEDGE TRANSMISSION

When the aircraft is on final approach, it is important that every transmission gets through. If the pilot had to "roger" every transmission it would be a waste of his or her time and might interfere with one of your transmissions. Therefore you must tell the pilot not to acknowledge any further transmissions by saying:

[Call sign] (pause)
Do not acknowledge further transmissions (pause)

As you know, the pilot has been warned to decide that radio contact has been lost if he or she doesn't hear from the controller at least once every minute in the pattern or every five seconds on final approach. Technically, the one minute rule applies until the "do not acknowledge..." transmission is given. When you get the handoff, you must take over the responsibility of giving transmissions at the one-minute rate. After you tell the pilot not to acknowledge further transmissions, you must maintain the five-second rate.

When should "do not acknowledge" be spoken? This is partly a matter of style, but you must give it before you tell the pilot to begin descent. Since the "approaching glidepath" call can be given up to 30 seconds before "begin descent," something must fill the gap. Most controllers find that the best sequence is this:

[Call sign]... Approaching glidepath ... Over

:

[Call sign]... Do not acknowledge further transmissions

:

Begin descent

THE LAW

TRANSMISSION ACKNOWLEDGEMENT

After contact has been established with the final controller and while on the final approach course, instruct the aircraft not to acknowledge further transmissions. Phraseology: "DO NOT ACKNOWLEDGE FURTHER TRANSMISSIONS."

Be very careful in your use of call sign and "over." Before the "do not acknowledge" call every transmission must begin with the call sign and end with "over." That's the reason you say "Call sign ... do not acknowledge further transmissions." But after this transmission you don't want the pilot to say anything more, so you don't say "over." The call sign is not used again until the end of the approach.

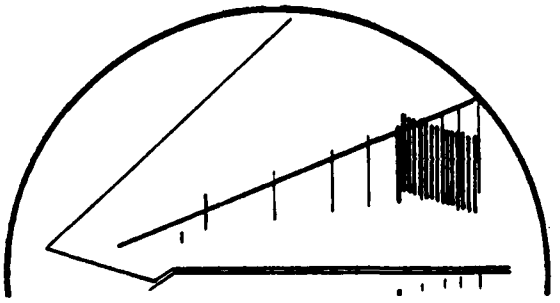
After this point you may keep your transmitter keyed throughout the approach. It is good practice however to release it occasionally so that the pilot could report an emergency should one arise. The GCA-CTS will check to make sure you release it at least once before the aircraft reaches one mile.

In later problems, the GCA-CTS will also check to make sure you are maintaining the five-second rule after the "do not acknowledge" transmission. For now though, don't concentrate on speed, concentrate on accuracy. When you become familiar with the procedures the five-second rate will be easy to maintain.

4.5 BEGIN DESCENT

"Begin descent" tells the pilot to start the standard rate of descent. For the 3° glideslope, this is about 500 to 800 feet per minute, depending upon the aircraft speed. You will learn to time this transmission so that the aircraft will settle down right on glidepath.

You have already noticed some peculiarities about the PAR display — the fact that heading angles are exaggerated, and that the target gets smaller and appears to speed up as it approaches touchdown. You will notice another peculiarity in the glidepath display. When the target is flying straight and level, it will appear to rise on the elevation display. Here is a target flying at 1500 feet. Don't be confused — it only appears to be climbing.

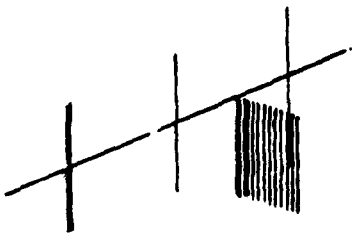


TARGET TRAIL WHEN AIRCRAFT IS FLYING LEVEL AT 1500'

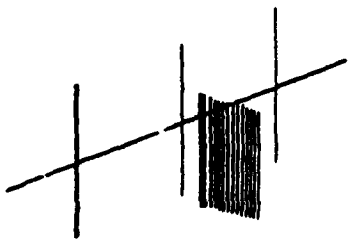
The transmission used to tell the pilot to start descending is:

Begin descent

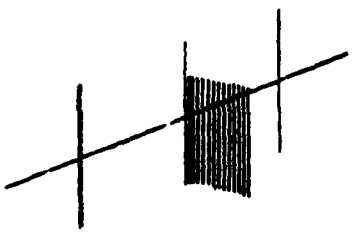
Here are some rules of thumb to help you know when to give it.



For a fast aircraft, give the transmission when the target just touches the cursor.



For a medium speed aircraft, give the transmission when the top one-third of the target is bisected.



For a slow aircraft, give the transmission just before the middle one-third of the target touches the cursor.

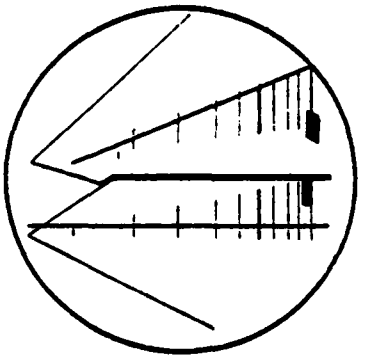
These rules of thumb should be modified slightly depending on the type of aircraft. A prop aircraft will typically begin to descend in three to six seconds. A jet tends to fall out of the sky more suddenly – you will see a lag time of only two to four seconds.

****
* THE LAW *
*
* DESCENT INSTRUCTION.
*
* When an aircraft reaches the point where final descent is to *
*
* start, instruct it to begin descent. Phraseology: "BEGIN *
*
* DESCENT." *
****

INITIAL CONTROL PROCEDURES

SUMMARY

This summary gives the recommended sequence of transmissions starting with radar contact. It shows how to put together what you have learned in the previous levels with what you have learned in this level. A medium speed aircraft approaching from right base was chosen for illustration. Go through it slowly. Visualize the PAR display with the aid of the pictures. Imagine that the target is really moving. (">...<" shows the pilot responses.)



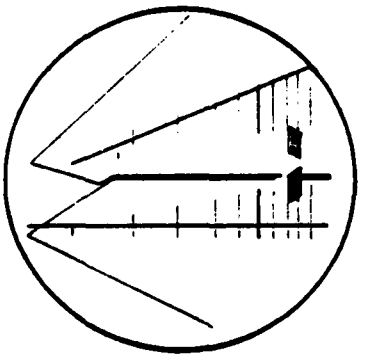
To pattern controller, "[Call sign]...radar button [#]"

"[Call sign]...this is your final controller, how do you hear me?"

>Loud and clear<

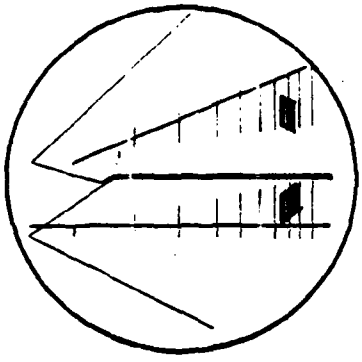
"[Call sign]...wheels should be down...over"

>Roger, wheels down and locked<



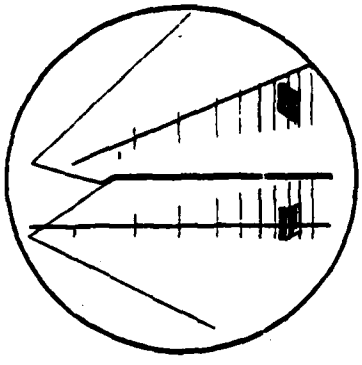
"[Call sign]...turn right heading...one...five... zero...over"

>Roger, turn right heading one five zero<



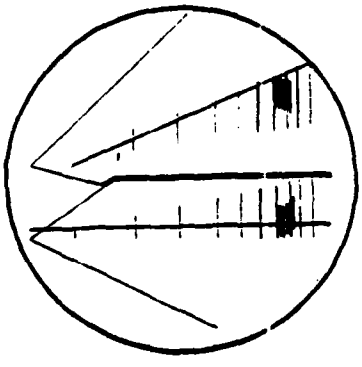
"[Call sign]...turn right heading...one. .five...five... over"

>Roger, turn right heading one five five<



"[Call sign]...turn right heading...one...six...zero... over"

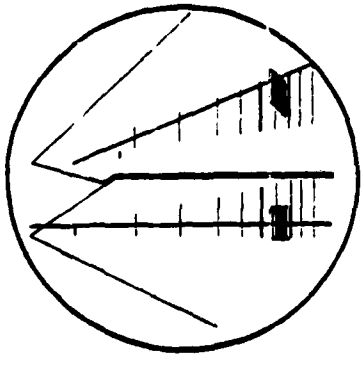
>Roger turn right heading one six zero<



'[Call sign]...approaching glidepath...over"

>Roger<

'[Call sign]...do not acknowledge further transmissions"



"Begin descent"

GRADING

In this level, these are the points the system will check.

Approaching Glidepath

	Partial Credit	Total Possible Points
A. Approaching glidepath		
1. Transmission given.	10	
2. Correct call sign and over used, if needed; otherwise not.	5	
3. Transmission given when aircraft is within the correct range:	5	

Aircraft Speed	Acceptable Range (miles)
100	0.25-0.75
115	0.33-1.00
130	0.38-1.16
160	0.44-1.33

4. Call transmitted only once during final approach.	5	
B. Do not acknowledge		
1. Transmission given.	10	
2. Correct call sign used.	5	
3. The phrase is not followed by "over."	5	
4. Transmitted prior to begin descent.	5	
C. Begin		
1. Transmission given.	10	
2. Transmitted within 10-30 seconds after approaching glidepath.	5	
3. Glidepath cursor intersects upper 1/3 of target.	10	
4. Transmitted only once during the approach.	5	
D. Wheel check		
1. Transmission must be given unless pilot responds "wheels down" to radio check, in which case it must not be given.	15	
2. Correct call sign and over must be used.	5	
		100

GRADING (continued)

Transmission Break

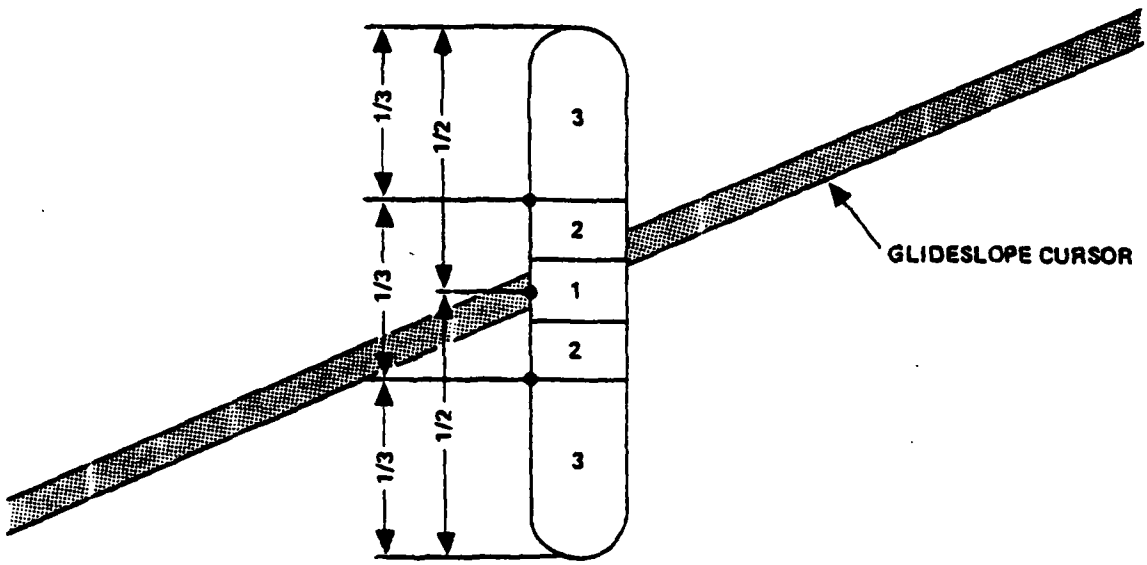
		Weighting Factor Applied to Percentage Error	Total Possible Points
A.	Mike unkeyed after "over"	.8	
B.	At least one given subsequent to do not acknowledge prior to one mile	.2	
			100

4.6 GLIDEPATH POSITION AND TREND

As in ASR final control, there is a fundamental difference between glidepath transmissions and course corrections. In both ASR and PAR, the pilot is responsible for maintaining the exact course headings you give. With glidepath information, it is up to the pilot to adjust his or her rate of descent to stay on glidepath. In ASR final control, the glidepath information consists of recommended altitudes given every mile. In PAR final control, it is much more precise. It will take some effort to become proficient in using the radio terminology.

Before going on to study this new topic, consider this: GCA control procedures were developed to make it possible for a pilot to land safely even if all the NAVAID gear fails while he or she is flying in pea soup. In such extreme conditions, the pilot's safety depends on <u>you</u>. Put yourself in his or her place – you would get very nervous if the controller sounded unsure or if he were constantly saying "correction," wouldn't you? The best way to give the pilot a sense of confidence in you is to have confidence in yourself. This means: learn your job well. PAR glidepath procedures may seem complicated, but there is a good reason behind every rule. Are you determined to learn the rules, even if it seems hard? Good. Let's go on.

GLIDEPATH POSITION. Glidepath position messages may be issued after the "begin descent" transmission has been given, not before. Glidepath position messages, like course position messages, are selected on the basis of target zones. Because the glideslope cursor is at an angle, you must be very careful to use the leading edge of the target return to determine aircraft position.



This picture shows the division of the elevation target into zones. As with course, if the cursor is between zones, select the zone closer to zone one.

There are specific glidepath position messages which must be given when the cursor passes through the target in each zone. Although a course position message may be omitted, this is not true of glidepath position messages. You must keep the pilot informed of his or her glidepath position, and inform him or her whenever the target moves into another zone. The only exceptions to this rule of giving a glidepath position message in every zone are those which relate to aircraft safety. A waveoff or low altitude alert always has higher priority than a glidepath position message. Likewise, the mile marks must get out, even if a glidepath message is skipped. No-gyro approach announcements also should be given, if necessary, instead of a glidepath position message. Finally, unless the target is well below glidepath, a well left/right of course message takes precedence over a glidepath message.

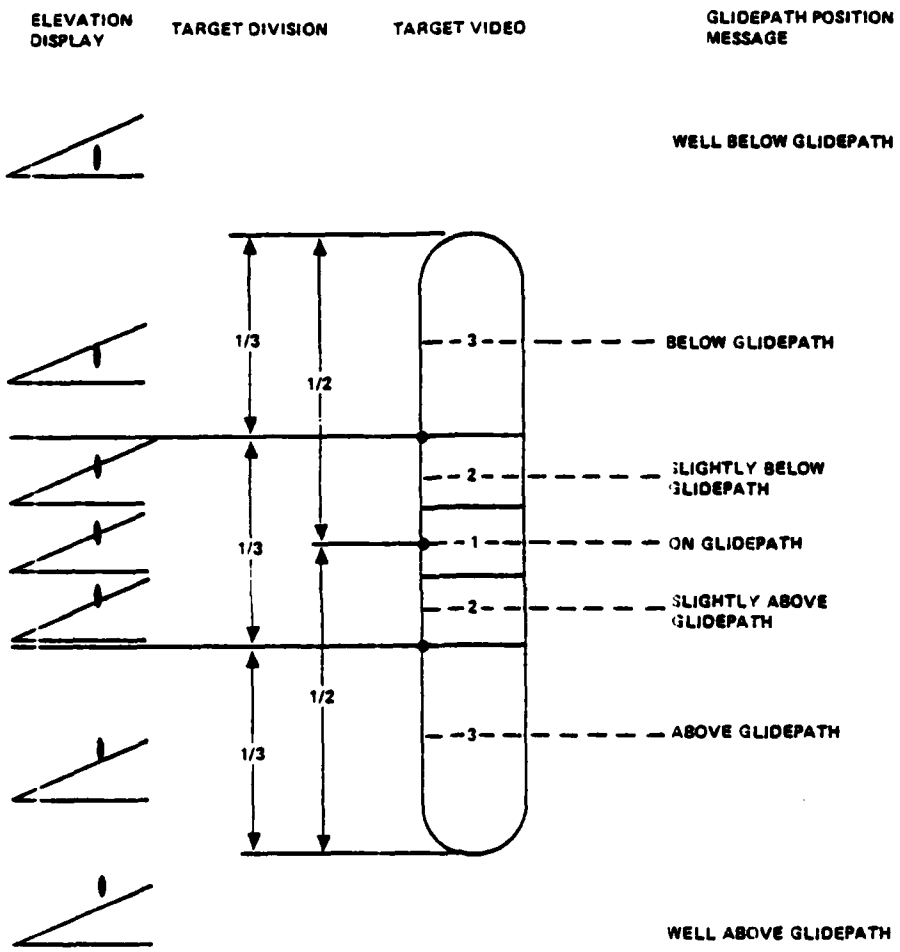
THE LAW

GLIDEPATH AND COURSE INFORMATION.

a. Issue course guidance and inform the aircraft when it is on glidepath and on course and frequently inform the aircraft of any deviation from glidepath or course.

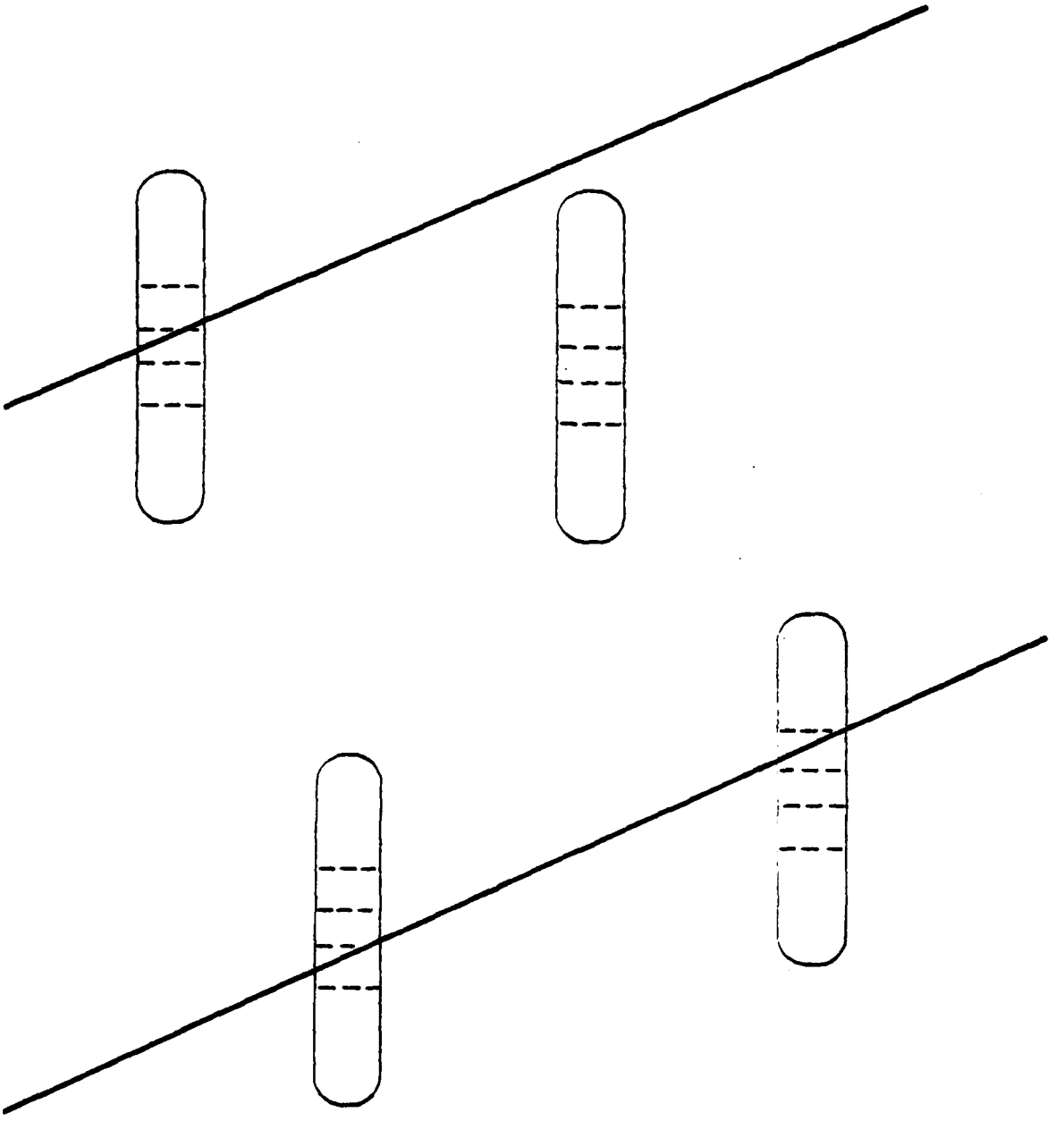
Phraseology: HEADING (heading). ON GLIDEPATH. ON COURSE OR SLIGHTLY/WELL ABOVE/BELOW GLIDEPATH. SLIGHTLY/WELL LEFT/RIGHT OF COURSE.

Study these position messages carefully. Do you see the similarity between these and the course position messages?

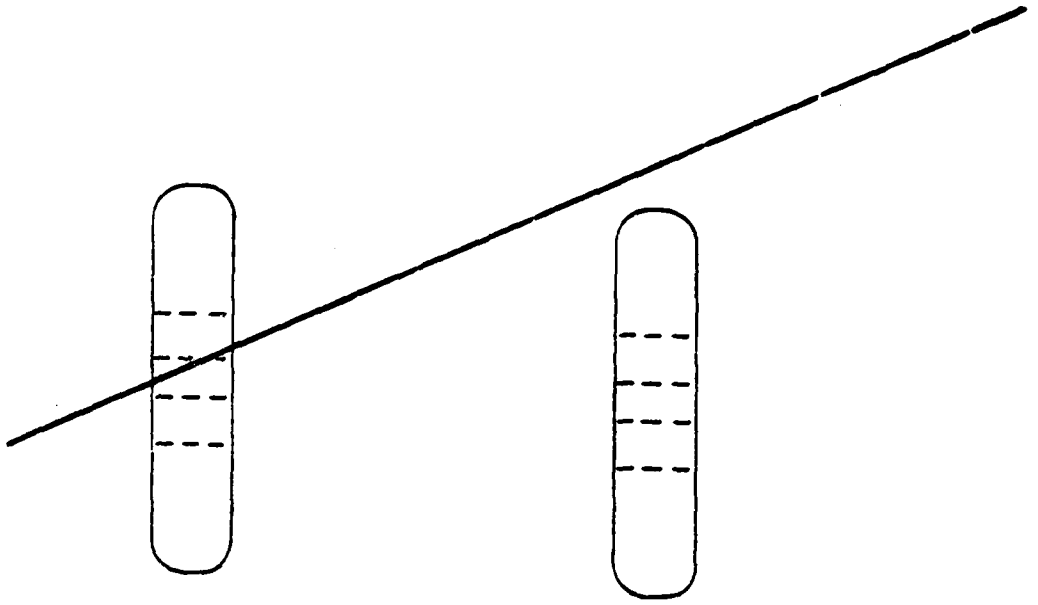


Don't turn the page until you have memorized these advisories.

Try these problems. Give the proper glidepath position message for each.

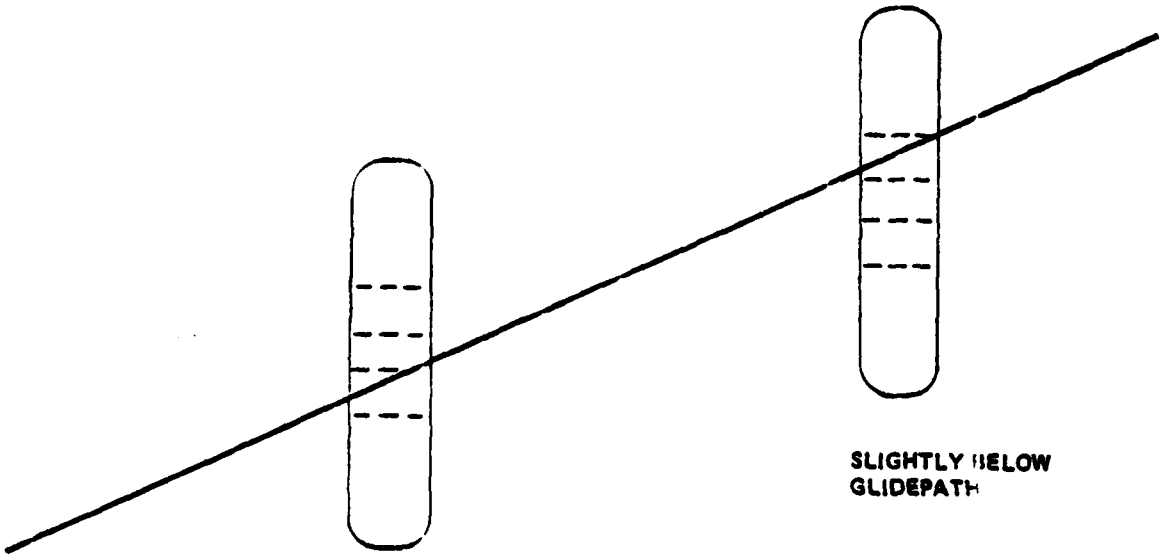


These are the answers.



ON GLIDEPATH

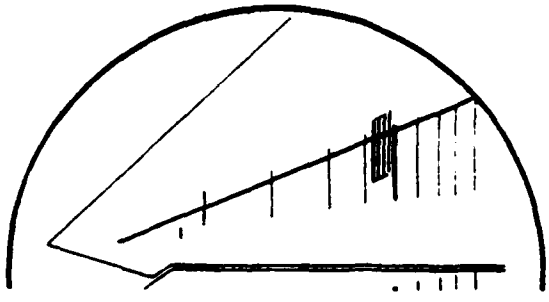
WELL BELOW GLIDEPATH

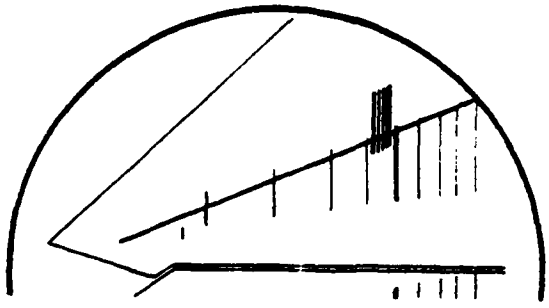


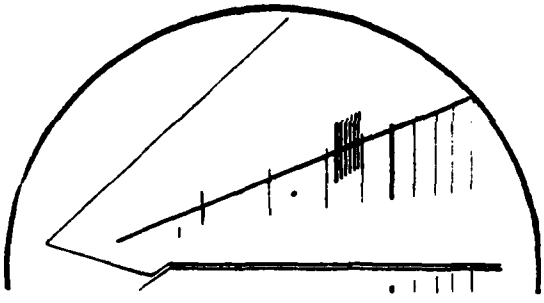
SLIGHTLY BELOW GLIDEPATH

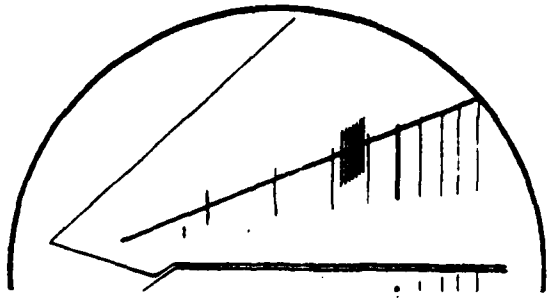
SLIGHTY ABOVE GLIDEPATH

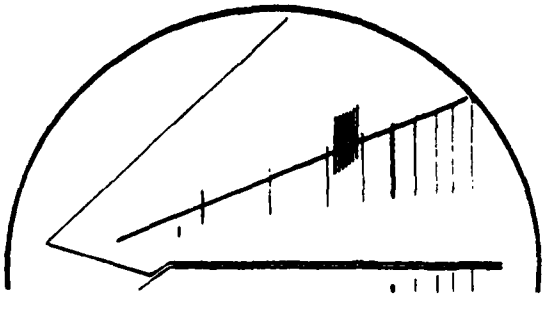
Here are some real examples. Try your hand at issuing the glidepath position information.

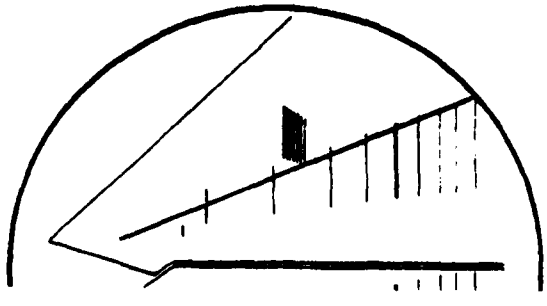




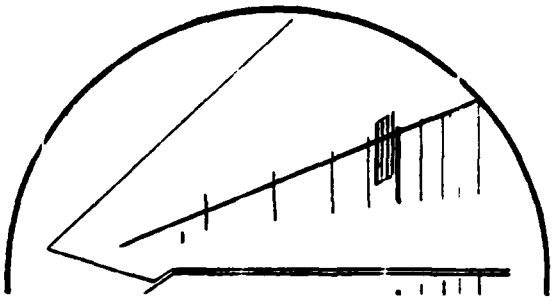




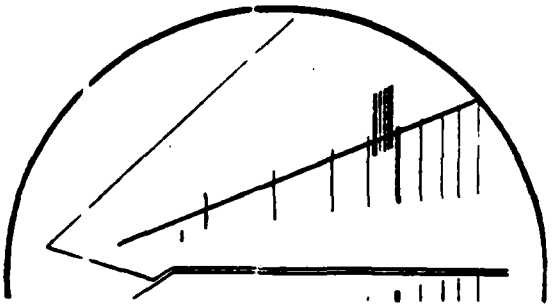




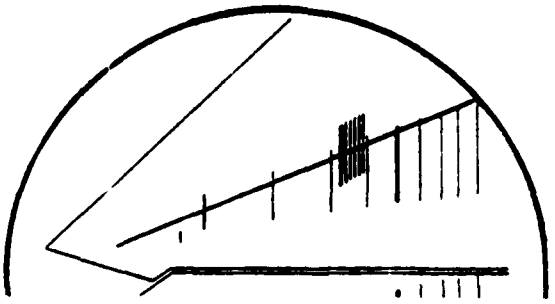
Here are the answers.



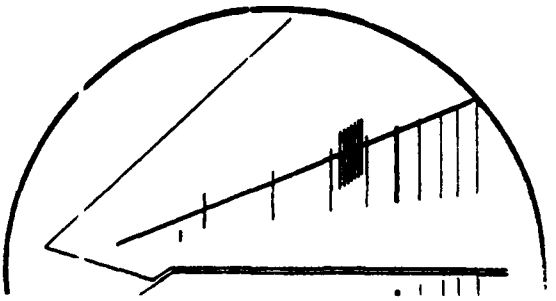
BELOW GLIDEPATH



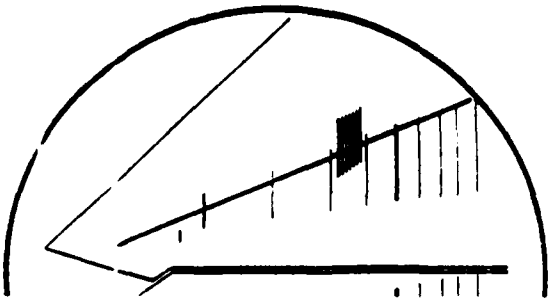
ABOVE GLIDEPATH



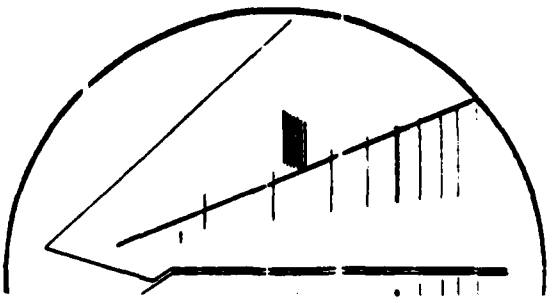
ON GLIDEPATH



SLIGHTLY BELOW GLIDEPATH



SLIGHTLY ABOVE GLIDEPATH



WELL ABOVE GLIDEPATH

GLIDEPATH TREND. Glidepath trend messages are as important as glidepath position messages. The rules are simple.

1. When the target is touching the glidepath cursor, issue one trend message between <u>different</u> position messages. This means that trend may be issued <u>only</u> once when the target changes zones.

2. In the well zones, when the target is not touching the cursor, the trend (coming up/down) may be repeated.

If the aircraft is correcting (that is, moving <u>toward</u> the glidepath the trend messages are coming up and coming down. This aircraft is:

well below glidepath ... coming up ... below glidepath

This aircraft is:

above glidepath ... coming down ... slightly above glidepath

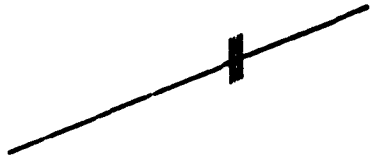
The term "coming" is used to mean the target is approaching, getting closer, correcting, coming home to the glidepath.

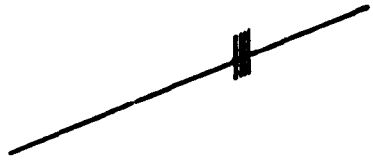
When the target is moving away from the glidepath, the term "going" is used. Here we must be careful though! The trend message chosen depends on the position zones. Whe the target moves from on, to slightly above/below, the trend is:

going above glidepath
or
going below glidepath

This aircraft is:

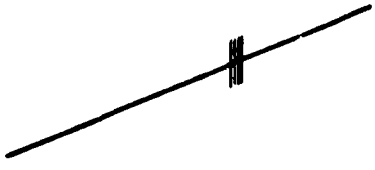
On glidepath ... going above glidepath ... slightly above glidepath

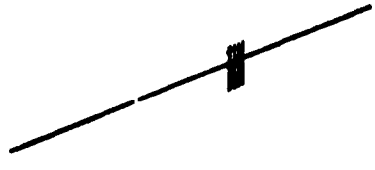




This aircraft is:

On glidepath ... going below glidepath ... slightly below glidepath





As the target moves away from the slightly position, the glidepath trend messages are:

Going further above glidepath

Going further below glidepath

This aircraft is:

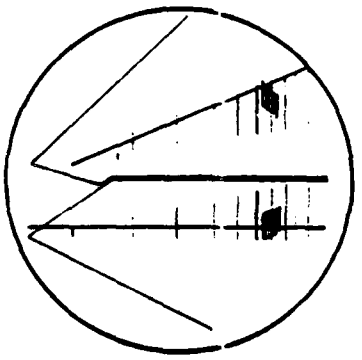
Slightly above glidepath ... Going further above glidepath ... Above glidepath ... Going further above glidepath ... Well above glidepath

This aircraft is:

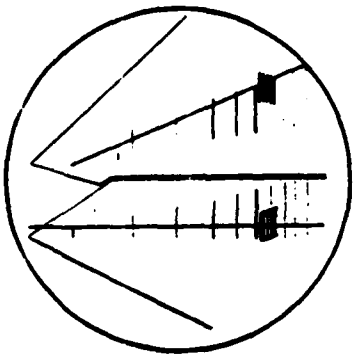
Slightly below glidepath ... Going further below glidepath ... Below glidepath ... Going further below glidepath ... Well below glidepath

Practice saying these messages until the order seems natural to you.

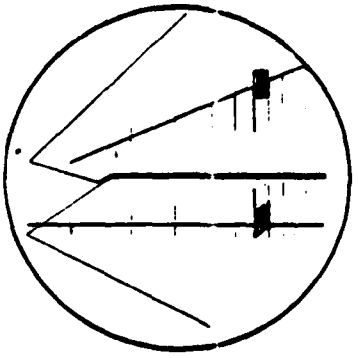
This sequence of pictures shows an aircraft on final. The begin descent transmission has been given. Visualize the control situation and write the transmissions you would give. You may write more than one message for each example. (Winds are light and variable.)



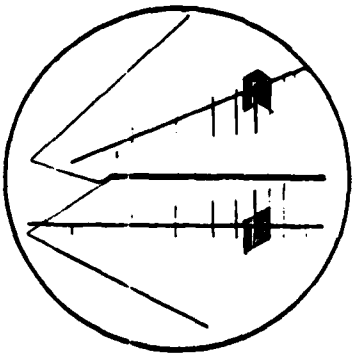
1.



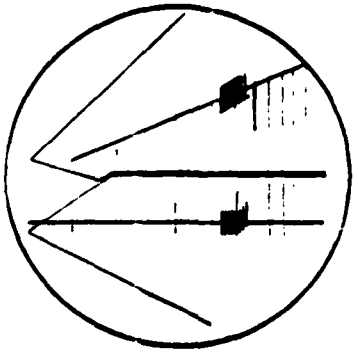
2.



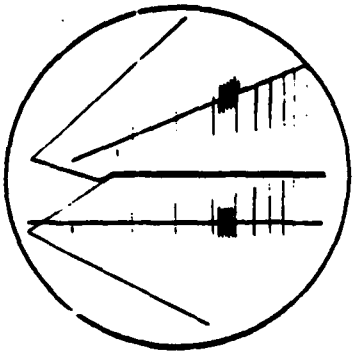
3.



4.

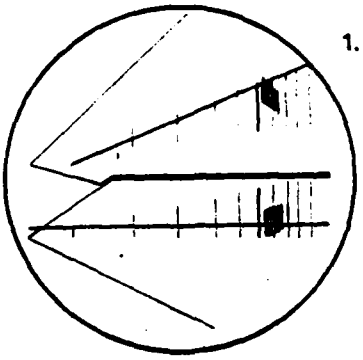


5.

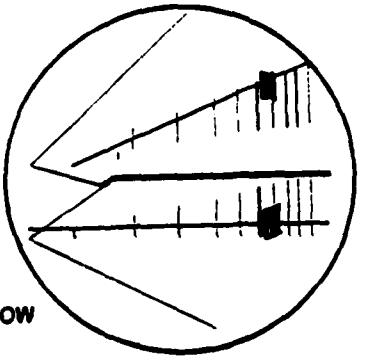


6.

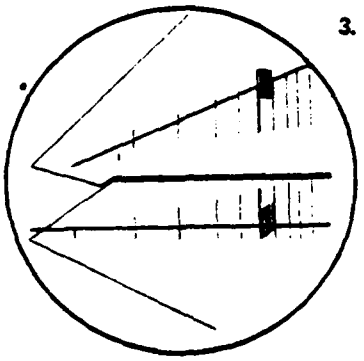
Here is what a good controller might have done. Did you think to give a turn? Remember to keep track of <u>both</u> displays.



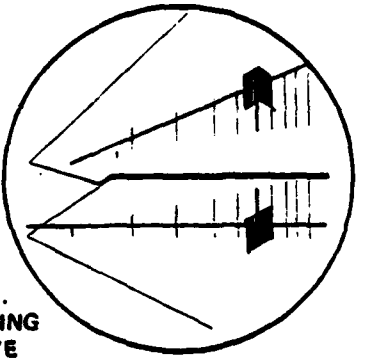
1. BELOW GLIDEPATH



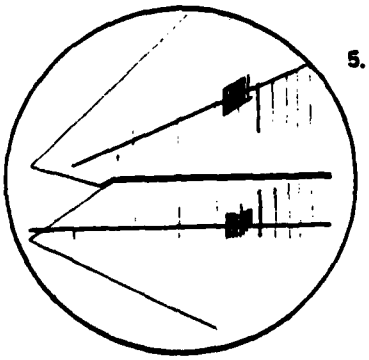
2. COMING UP... SLIGHTLY BELOW GLIDEPATH



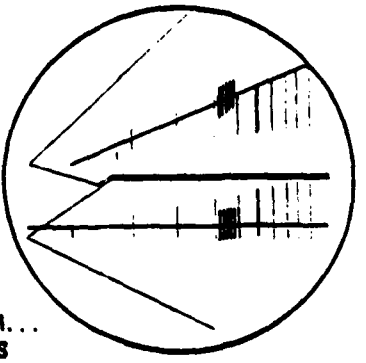
3. 4 MILES FROM TOUCHDOWN... COMING UP... ON GLIDEPATH



4. LEFT OF COURSE... TURN RIGHT HEADING ...ONE...SIX...FIVE



5. ON GLIDEPATH... TURN LEFT HEADING... ONE...SIX...ZERO

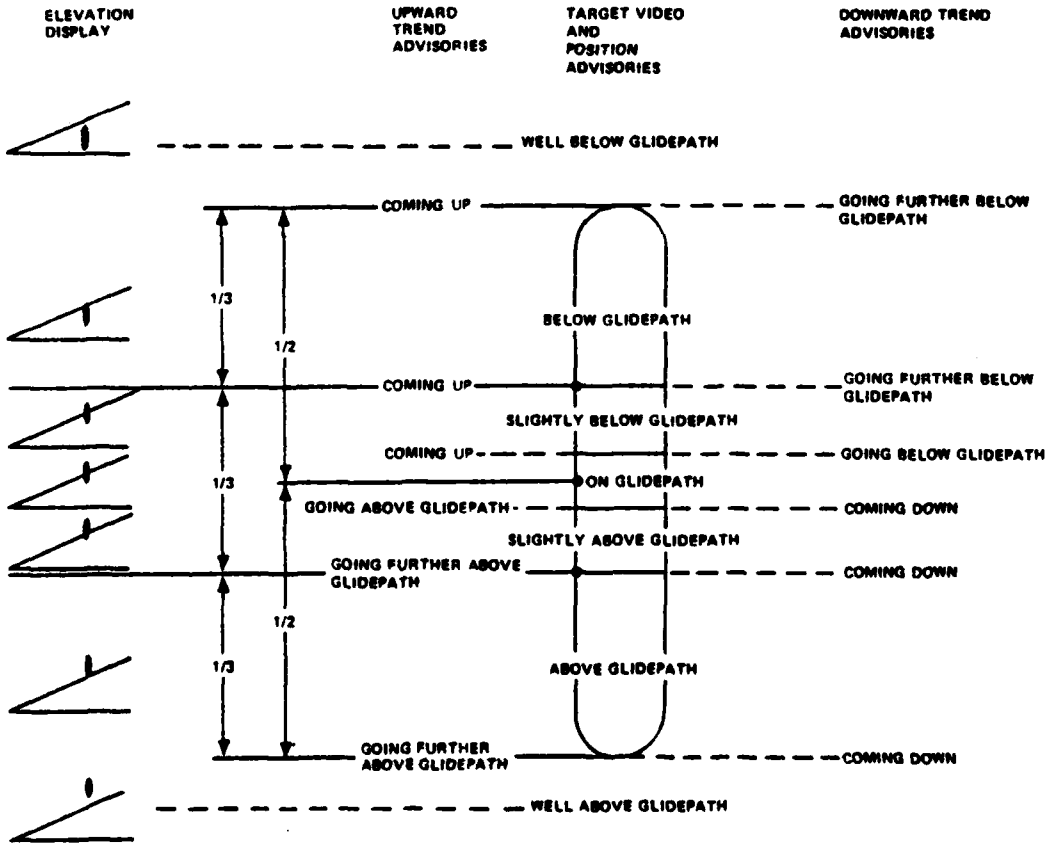


6. GOING ABOVE GLIDEPATH... SLIGHTLY ABOVE GLIDEPATH... ON COURSE ... THREE MILES FROM TOUCHDOWN

GLIDEPATH POSITION AND TREND

SUMMARY

1. A glidepath position message must be given whenever the target changes zones.
2. If the target remains in the same glidepath position, the position message may be repeated.
3. Different glidepath position messages must be separated by one glidepath trend message.
4. Glidepath trend messages may not be repeated while the aircraft remains in the same position.
5. The correct calls are shown below:



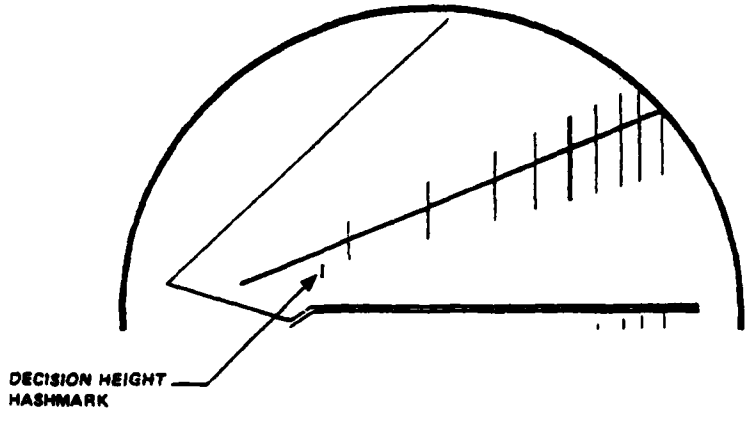
GRADING

GLIDEPATH POSITION AND TREND

	Weighting Factor Applied to Percentage Error	Total Possible Points
A. For all glidepath messages, begin descent must have been given	.10	
B. Position calls		
1. Position must be correct	.15	
2. A position call must be made whenever target changes zones, unless superseded by a priority call	.15	
C. Trend calls		
1. Trend must be correct	.15	
2. Trend must be issued if the target moves from one zone to another	.15	
3. Trends must not be issued successively except in well zone	.15	
4. Trends must not separate identical position messages except in well zone	.15	
		100

4.7 DECISION HEIGHT

Decision height is the minimum descent altitude for an IFR approach. If the pilot does not have visual contact with the field at this point, he or she is required to execute a missed approach. Technically, your responsibility ends at decision height, because the pilot is expected to take over visually. If the pilot is making a low approach, he or she will begin to climb out at decision height. For other types of approaches you should continue to give transmissions until the target reaches landing threshold. You must inform the pilot when the aircraft reaches the decision height. This is actually a range call, and is not based upon target altitude. The transmission is given when the target reaches the decision height hashmark, a small mark to the left of the one-mile mark on the elevation display. This shows the range at which an aircraft that was on glidepath would be at the published decision height.



To inform the pilot of this, say,

At decision height

****
* THE LAW *
* *
* DECISION HEIGHT. *
* *
* Inform the aircraft when it reaches the published decision *
* height. *
* *
* Phraseology: AT DECISION HEIGHT. *
* *
****

A low approach will terminate at decision height. When you see the aircraft begin to climb out, notify the pattern controller by saying,

On the go (pause)
[Call sign] (pause)
Button [#] (pause)

At decision height, if the target is not touching either or both of the cursors, you must give the missed approach option, as follows:

For all approaches this sequence is acceptable:

Too [low, far left, far right, high] for safe approach (pause)
If runway not in sight execute missed approach (pause)
Climb and maintain one thousand five hundred (pause)
Turn right heading (pause)
Three (pause)
Zero (pause)
Zero (pause)

For full stop approaches, you don't have to repeat the missed approach instructions. You may say:

Too [low, far left, far right, high] for safe approach (pause)
If runway not in sight execute missed approach (pause)

You must give only one reason for the missed approach option, even if the target is not touching either cursor. Select the most important reason. What would the order of importance be? Obviously, the most dangerous condition is low altitude.

Importance of transmissions:

most	Too low for safe approach
↓	Too far [right/left]...
least	Too high...

If the pilot waves off, hand the aircraft off to the pattern controller as you did before:

1. Select ICS 5
2. Say to the pattern controller,

   Missed approach (pause)

   [Call sign] (pause)

   One mile (pause)

   Button [#] (pause)
3. Deselect the radio frequency
4. Select the radio frequency MON button
5. When you hear the pattern controller report radar contact, deselect MON.

AT DECISION HEIGHT

SUMMARY

1. When the leading edge of the target touches the decision height hashmark, say, "At decision height."

2. For a low approach, when the target begins to climb out after decision height, follow the following procedures:

   a. Select ICS 5
   b. Report to the pattern controller, "On the go...button [#]"
   c. Deselect the radio frequency XMIT button
   d. Select the MON button
   e. When the pattern controller reports "Radar button [#]," deselect MON.

3. If the target is not touching either or both cursors, give the missed approach option, saying, "Too [low, far left, far right, high] for safe approach...if runway not in sight execute missed approach...climb and maintain one thousand five hundred...turn right heading...three...zero...zero."

4. If the pilot takes the missed approach option, notify the pattern controller using the usual procedure:

   a. Select ICS 5
   b. Say to the pattern controller, "Missed approach...[Call sign]...one mile...button [#]"
   c. Deselect the radio frequency XMIT button
   d. Select the MON button
   e. When the pattern controller reports "Radar button [#]," deselect MON.

GRADING

DECISION HEIGHT PROCEDURE

		Partial Credit	Total Possible Points
A.	Decision height call		
	1. "At decision height" is given*	25	
	or		
	2. If target is not touching, "at decision height" is followed by highest priority correct position	25	
B.	Range		
	1. DH announced within .8 miles from touchdown*	20	
	2. DH announced prior to .7 miles from touchdown*	25	
C.	Call is made only once during the approach	5	100

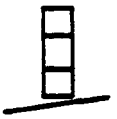
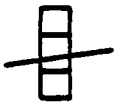
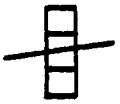
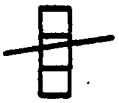
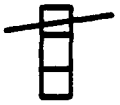
MISSED APPROACH OPTION AT DECISION HEIGHT

A.	Target not touching when decision height message given and missed approach option issued*	50	
B.	"Too low" used if target was too low, else some "too" message is used. (The correctness of the "too" message is scored in A2b above)*	25	
C.	Proper R/T for type of approach	25	100

*Safety error

LEVEL FOUR

RADIO TERMINOLOGY SUMMARY

Event	PAR Controller Response	Purpose
Target reaches a point 10-30 seconds from the begin descent point	"[Call sign]...approaching glidepath...over"	Warns pilot that descent will begin shortly
Just before begin descent is to be spoken	"[Call sign]...do not acknowledge further transmissions"	Tells pilot not to roger transmissions, also that five second rule now applies
Target reaches begin descent point	"Begin descent"	Tells pilot to begin standard rate of descent
Target above and not touching glidepath cursor 	"Well above glidepath"	Glidepath position information
Glidepath cursor intersecting lower 1/3 of target 	"Above glidepath
Glidepath cursor intersecting lower half of middle 1/3 of target 	"Slightly above glidepath"
Glidepath cursor bisecting target 	"On glidepath"
Glidepath cursor intersecting upper half of middle 1/3 of target 	"Slightly below glidepath"
Glidepath cursor intersecting upper 1/3 of target 	"Below glidepath"
Target below and not touching glidepath cursor 	"Well below glidepath"

RADIO TERMINOLOGY SUMMARY (continued)

Event	PAR Controller Response	Purpose
Target moves toward on zone from above	"Coming down"	Glidepath trend information
Target moves toward on zone from below	"Coming up"	
Target moves from on to slightly above	"Going above glidepath"	
Target moves from on to slightly below	"Going below glidepath"	
Target moves away from slightly above	"Going further above glidepath"	
Target moves away from slightly below	"Going further below glidepath"	
Leading edge of elevation target touches decision height hashmark	"At decision height"	Informs pilot that minimum descent altitude has been reached
Low approach climb out begins	Over ICS 5: "On the go...[Call sign]...button [#]	Informs pattern controller low approach has terminated
Target not touching at decision height, any type of approach	"Too [low, far left, far right, high] for safe approach...if runway not in sight execute missed approach...climb and maintain one thousand five hundred...turn right heading...three ...zero...zero"	Missed approach option legal for all types of approaches
Target not touching at decision height, full stop approach	"Too [low, far right, far left, high] for safe approach...if runway not in sight execute missed approach"	Alternative missed approach option for full stop only

LEVEL FIVE

FIVE-SECOND RULE AND LANDING THRESHOLD SEQUENCE

5.0 INTRODUCTION

In this level you will learn approach termination procedures. You will also learn to time your messages properly. You will learn:

- To abide by the five-second rule
- To give the landing threshold and final course postion messages
- To give the rollout instructions
- To give a handoff to the pattern controller.

5.1 FIVE-SECOND RULE

You will recall the radio contact lost instructions you used to give when you served as the pattern controller: "If no transmissions are received for one minute in the pattern or five seconds on final approach..." The five-second rule takes effect as soon as you give the "Do not acknowledge" transmission. Up to this point in the course we have concentrated upon accuracy. Now that you have become familiar with control procedures, you should think about the timing of your transmissions too. If you talk too fast, the pilot won't be able to respond to your transmissions. If you wait too long between transmissions, the pilot will have to respond to radio contact lost and wave off or revert to a TACAN approach. A professional air traffic controller issues transmissions calmly, clearly, and rhythmically. Unless there is an emergency brewing, you should allow four seconds between your transmissions.

Some professional controllers recommend a mix of about three glidepath calls to every course call, but this is only a very rough guideline – you have to decide at every moment what the best message is.

In this level the pilot will obey the five-second rule, so you must strive to give a call at least every five seconds. This won't be hard for you — five seconds is a long time. In fact, if you listen carefully to a replay of one of your approaches, you may find that you are actually talking too fast, not too slowly. If so, slow down! Give the pilot plenty of time to respond. The GCA-CTS has no TACAN facilities so if the five-second rule is violated, the pilot will wave off. In real life, the pilot would do this only as a last resort. If the pilot does decide to wave off because of lost communications, you must coordinate his or her missed approach with the pattern controller. You learned this procedure in level three. Reviewing briefly, you must:

1. Select ICS 5
2. Say to the pattern controller, "missed approach...[call sign]...[map position]...button [#]
3. Deselect the radio frequency
4. Select MON
5. When you hear the pattern controller report radar contact, deselect MON.

You should know something about how the GCA-CTS pilot thinks. The pilot doesn't want to take a wave off due to lost communications if it can be helped. Like a real pilot, he or she will hear you if you cough or key the mike and will know that the radio is OK. However, even though the pilot does not wave off, you will be graded on the rate at which you issue transmissions, not coughs.

GRADING

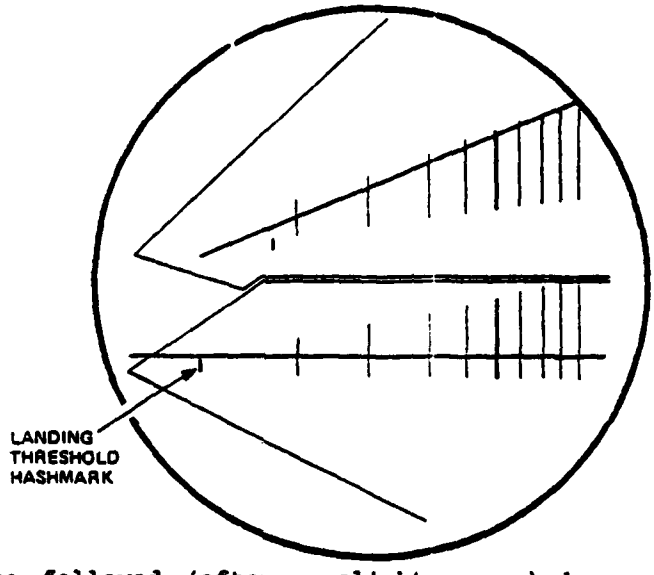
TRANSMISSION RATE

	Total Possible Points
A. Transmission rate after do not acknowledge advisory: not more than 5 seconds between transmissions (always reported at decision height)	100

5.2 OVER LANDING THRESHOLD

There is a transmission to use to inform the pilot that it is safe to touch down. When the leading edge of the azimuth target touches the landing threshold hashmark, say,

Over landing threshold



This transmission must be followed (after a slight pause) by position with respect to the centerline of the runway, and "over." Since the pilot will have taken over visually at decision height, this position should be, at worst, slightly left or right. The target division scheme is the same as always, but now, since the aircraft is actually over the runway, the transmissions are slightly different. Here are the various possibilities. If the aircraft is slightly off course, use:

Over landing threshold (pause)
Slightly right of centerline (pause)
Over (pause)

or:

Over landing threshold (pause)
Slightly left of centerline (pause)
Over (pause)

If the target is bisected by the azimuth cursor you may say either:

Over landing threshold (pause)

On centerline (pause)

Over (pause)

Or simply:

Over landing threshold (pause)

Over (pause)

THE LAW

POSITION ADVISORIES.

c. Inform the aircraft when it is passing over the landing threshold and inform it of any deviation from centerline. Phraseology: OVER LANDING THRESHOLD (position with respect to centerline).

5.1 ROLLOUT INSTRUCTIONS

If the aircraft is making a full stop approach, you must give the pilot the rollout instructions and relinquish the radio frequency. Approximately 20-40 seconds after giving the "over landing threshold" transmission, remind the pilot:

Contact tower after landing (pause)
Over (pause)

The pilot will roger this transmission. You must then deselect the radio frequency, select ICS 5 for the pattern controller and tell him or her:

Button one clear

or

Button two clear

The pattern controller will roger this information and your responsibility for this approach is complete. Leave ICS 5 selected so you can hear the next handoff for your position.

FULL STOP APPROACH TERMINATION

SUMMARY

1. When the leading edge of the azimuth target touches the landing threshold hashmark, if the aircraft is on the centerline, transmit:

   "Over landing threshold...over"

   or

   "Over landing threshold...on centerline...over"

   If the aircraft is not on centerline, transmit

   "Over landing threshold...[position with respect to centerline] ...over."

2. Approximately 20-40 seconds after the over landing threshold advisory, issue the rollout instructions "Contact tower after landing...over."

3. After the pilot rogers the rollout instructions, deselect the radio frequency.

4. Select ICS 5 and inform the pattern controller "Button [#] clear."

5.4 HANDOFF TO THE PATTERN CONTROLLER

In Level Four you learned to give the handoff to the pattern controller after low approach termination. You must also hand the aircraft back to the pattern controller when the aircraft is making a touch-and-go. On a low approach, you will see the aircraft climb out at decision height. On a touch-and-go, the pilot will continue the approach past the landing threshold. When you see the climb out begin after a low approach, or when the pilot rogers the over landing threshold advisory, start the handoff procedure. To review, it is:

1. Select ICS 5
2. Say to the pattern controller:
   On the go (pause)
   [Call sign] (pause)
   Button [#] (pause)
3. Deselect the radio frequency
4. Select MON
5. When you hear the pattern controller report radar contact, deselect the MON button
6. Keep ICS 5 depressed so you can hear the next handoff.

If you fail to give the handoff, the pattern controller will ask, "Position four, where is [call sign]?" You should respond with the appropriate handoff.

TOUCH-AND-GO TERMINATION

SUMMARY

1. When the leading edge of the azimuth target touches the landing threshold hashmark, if the aircraft is on centerline, transmit, "Over landing threshold...over" or "Over landing threshold...on centerline...over." If the aircraft is not on centerline, transmit "Over landing threshold... [position with respect to centerline]...over."
2. After the pilot rogers the over landing threshold sequence, select ICS 5.
3. Report to the pattern controller, "On the go...button [#]."
4. Deselect the radio frequency XMIT button.
5. Select the MON button.
6. When the pattern controller reports radar contact, deselect MON.

LOW APPROACH TERMINATION
(REVIEW)

SUMMARY

1. Select the ICS 5.
2. Report to the pattern controller, "On the go...button [#]."
3. When the aircraft begins to climb out after the decision height message, deselect the radio frequency XMIT button.
4. Select the MON button.
5. When the pattern controller reports "Radar button [#]," deselect MON.

GRADING

OVER LANDING THRESHOLD

		Partial Credit	Total Possible Points
A.	Over landing threshold		
	1. Advisory given	20	
	2. Given with ± second of the target contacting the landing threshold point	20	
B.	Final course position		
	1. Given within three seconds of "over landing threshold"	20	
	2. Position correct (including "over" for on position)	20	
	3. "Over" is used correctly	20	
			100

GRADING

HANDOFF AND ROLLOUT PROCEDURES

	Partial Credit	Total Possible Points
A. Rollout instructions on full stop landing		
1. Rollout instructions given	40	
2. Instructions issued 20-40 seconds after "over"	20	
3. Release radio frequency within 10 seconds after rollout instructions	20	
4. Notify pattern controller	20	
or		
B. Handoff to the pattern controller made if aircraft is on low approach or touch-and-go, or executing a missed approach including lost communications		
1. Handoff is given	40	
2. Handoff is made within 30 seconds of:	10	

Condition	Reference Point
Waveoff	Issuance of waveoff
Low approach	Decision height
Touch-and-go	Landing threshold

3. Call sign and buttons correct	10	
4. If missed approach, range must be given to nearest 1/2 mile, else not	10	
5. Monitor frequency and ICS until pattern transmits "[Call sign] radar"	10	
6. Release radio frequency	10	
7. Pattern ICS selected during handoff	10	
		100

LEVEL FIVE

RADIO TERMINOLOGY SUMMARY

Event	PAR Controller Response	Purpose
Target, centered on azimuth, touches landing threshold	"Over landing threshold... over" "Over landing threshold... on centerline...over"	Landing threshold message
Target, not centered on azimuth, touches landing threshold	"Over landing threshold... [position with respect to centerline]...over"	Landing threshold message
Full stop approach 20-40 seconds after over landing threshold	"Contact tower after landing...over"	Rollout instructions
Full stop approach after rollout instructions	Over ICS 5: "Button [#] clear"	Releases radio frequency
Touch-and-go, after over landing threshold advisory	Over ICS 5: "On the go... [Call sign]...button [#]"	Handoff to pattern controller

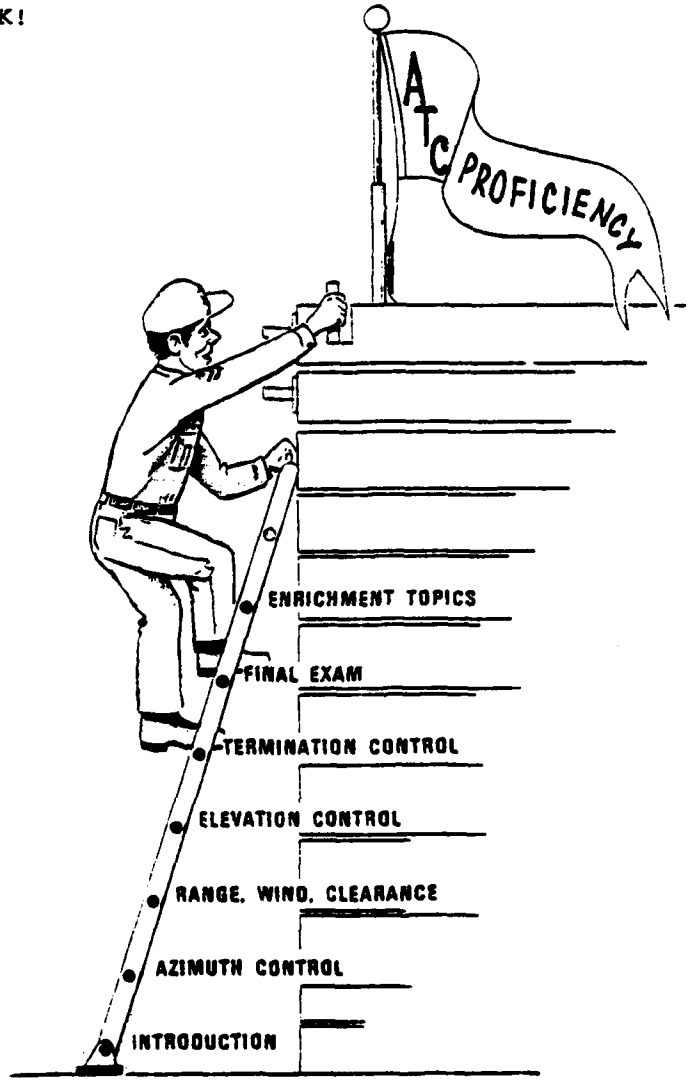
LEVEL SIX

PRACTICE AND P-RUN

There isn't any reading to do for this level! (You may want to read over all the yellow summary pages just to make sure you know all the procedures.)

In this level, you will be given practice problems of all types. When you have enough experience and are getting good grades, you will have your P-run. It will be a simple problem that you will be able to do easily.

GOOD LUCK!



GRADING

P-RUN

These are the procedures that will be scored on the P-run. To pass, you will have to achieve the scores shown.

Topic	Score
Accepting the handoff	90
Radio check	90
Turn to final	90
Heading vectors	90
Course position and trend	90
Range calls	90
Clearance procedure	90
Approaching glidepath related procedures	90
Transmission break	90
Glidepath position and trend	90
Decision height procedure	90
Missed approach option at decision height	90
Transmission rate	90
Over landing threshold	80
Handoff and rollout procedures	80

LEVEL SEVEN

ENRICHMENT TOPICS

7.0 INTRODUCTION

In this level you will learn to handle these emergency situations:

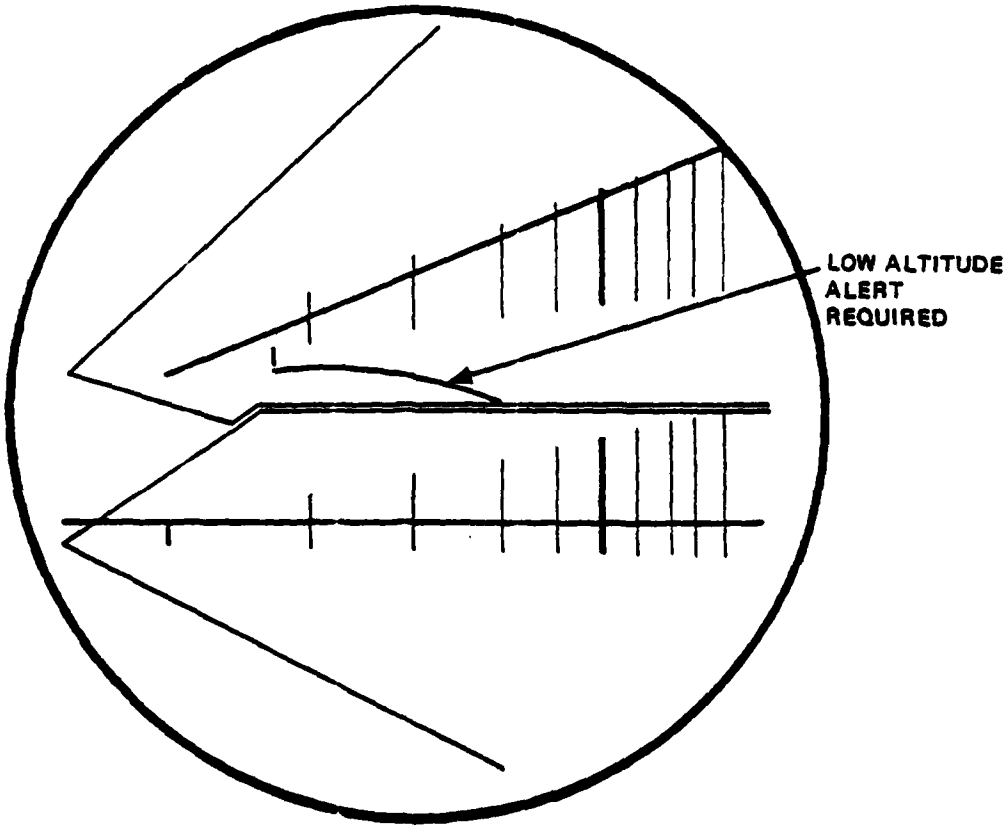
- To give the low altitude alert transmission
- To servo to maintain radar contact
- To detect conditions requiring an emergency waveoff
- To detect gyro failure and conduct a no-gyro approach.

7.1 LOW ALTITUDE ALERT

As the aircraft nears touchdown, you must watch carefully to make sure it does not get too low. A well below glidepath situation is always critical. You must be familiar with the local terrain and obstructions so you can alert the pilot to them. At the GCA-CTS installation there are no obstructions in the flight path. However, if the target drops to a point where the number of target widths below glidepath is equal to the number of miles from touchdown, issue a low altitude alert by saying:

Low altitude alert check your altitude immediately (pause)

This picture gives an idea of the altitudes at which a low altitude alert is required.



GRADING

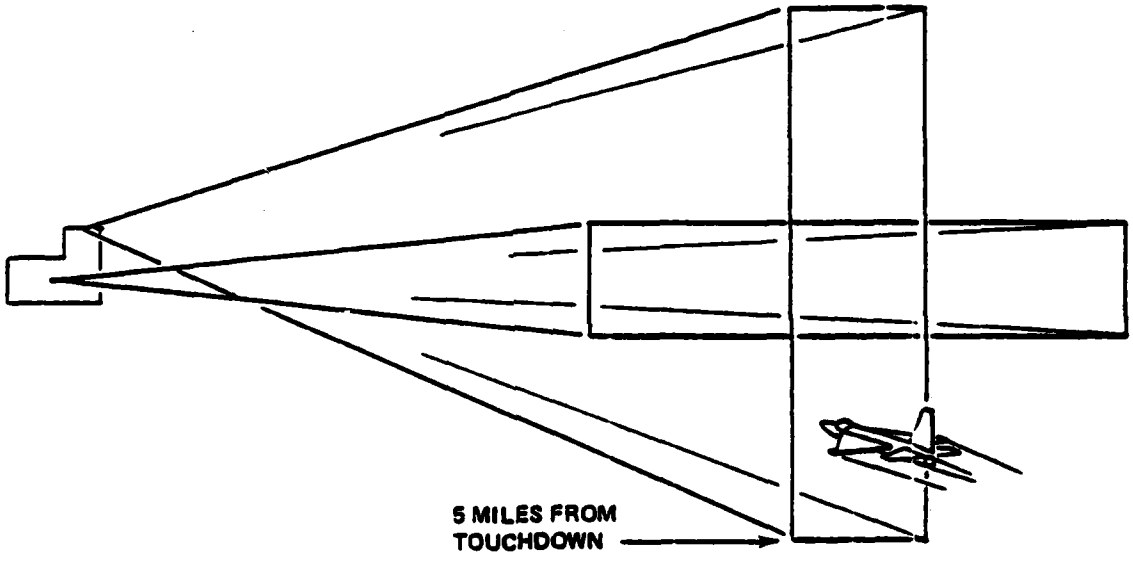
LOW ALTITUDE ALERT

	Partial Credit	Total Possible Points
A. Low altitude alert		
1. Transmitted when target exceeds one target width per mile below glidepath	50	
2. Issue within 5 seconds	50	
		100

7.2 SERVOING TO MAINTAIN RADAR CONTACT

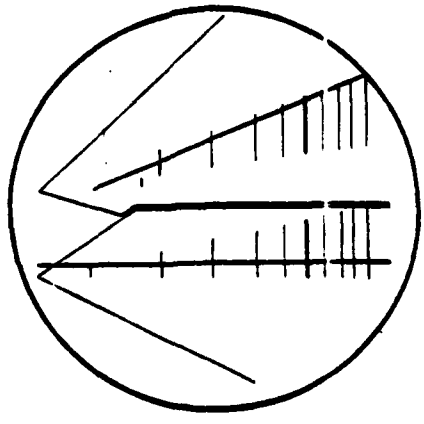
Up to this time, the servo has not beer used during your practice runs, so you haven't had to worry about losing radar contact because of antenna position. In this level, the servo will be functional, and you will have to be careful to maintain radar contact. Let's look at some examples of potential control situations.

Suppose you are flying behind this aircraft and have special glasses that enable you to see the radar scan. It looks like this:

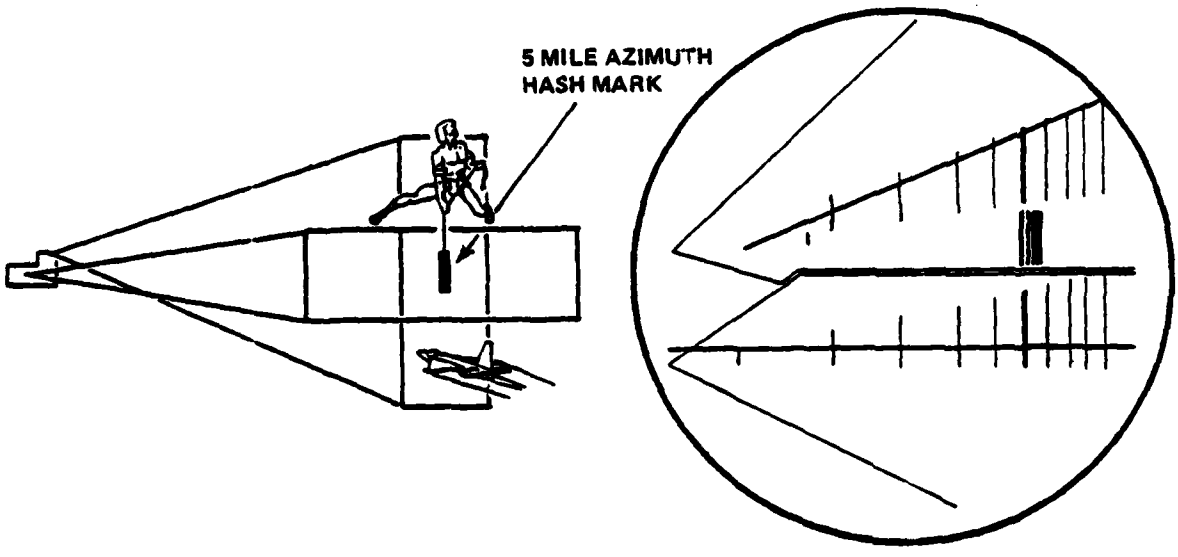


BEFORE TURNING THE PAGE

Draw the target in the appropriate place on this picture.



Does your picture look like this?



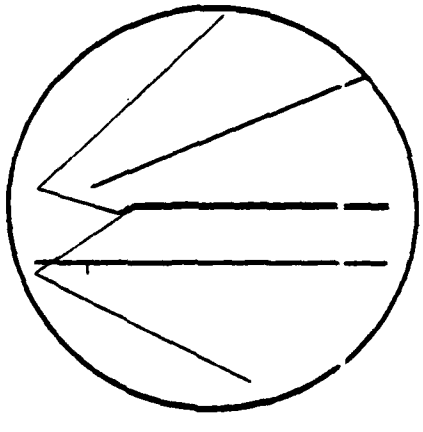
There are three important details:

1. The target appears on the elevation display.
2. It is <u>below</u> the five-mile hashmark (<u>not</u> touching it)
3. The target does <u>not</u> appear on the azimuth display.

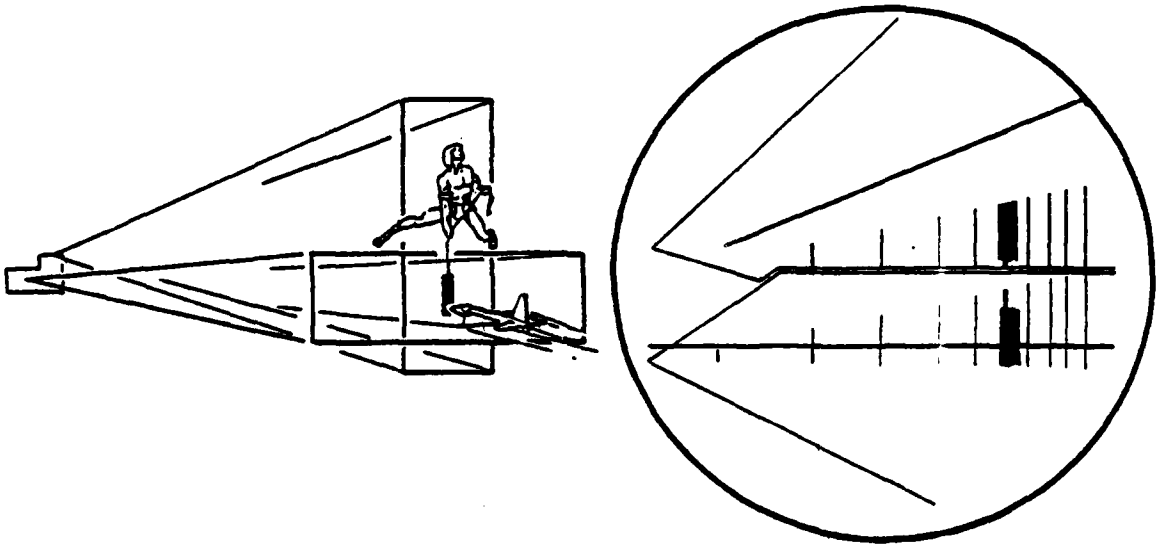
Do you understand all three points?

BEFORE TURNING THE PAGE

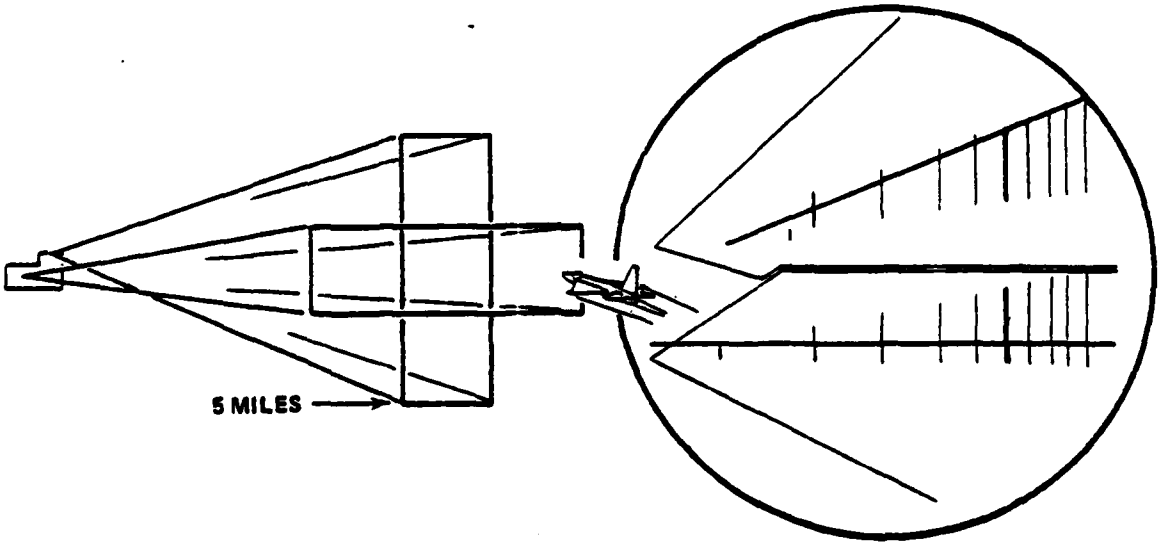
What would you have to do to make the target appear on the azimuth display? Visualize the procedure. Draw the new picture here.



You probably said, "to make the azimuth target appear, I'd have to servo down." Right!



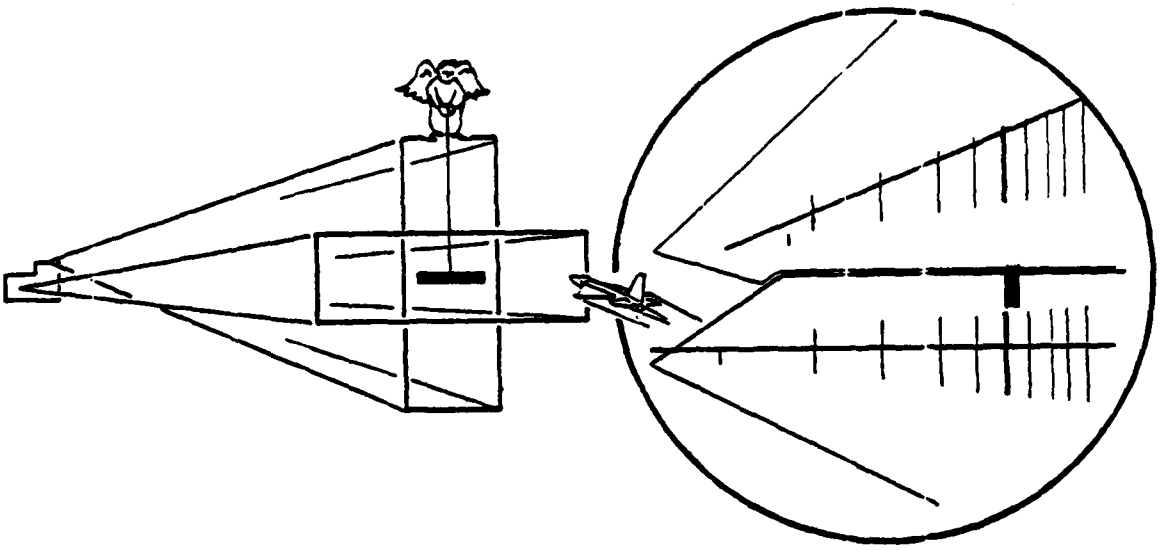
Let's try another one. (The aircraft is well to the right.)



BEFORE TURNING THE PAGE

Draw the target on the picture of the display.

Your picture probably looks like this.

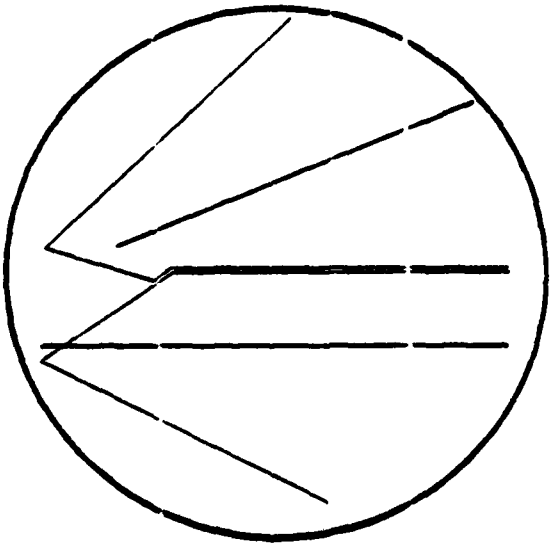


Again, notice three things.

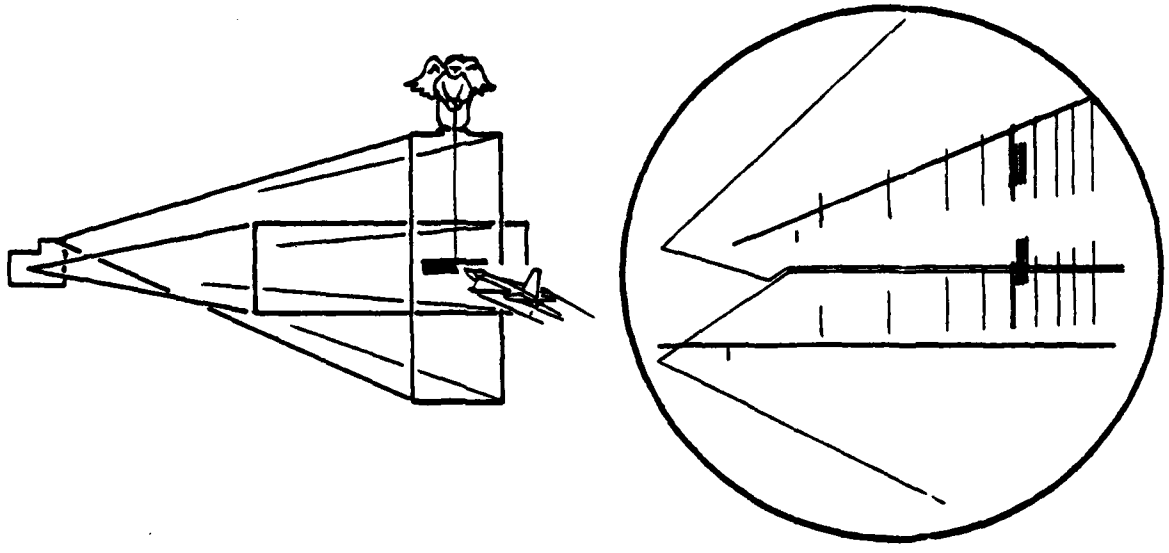
1. The target appears on the azimuth display.
2. It is right of the five-mile hashmark (not touching it)
3. The target does not appear on the elevation display.

BEFORE TURNING THE PAGE

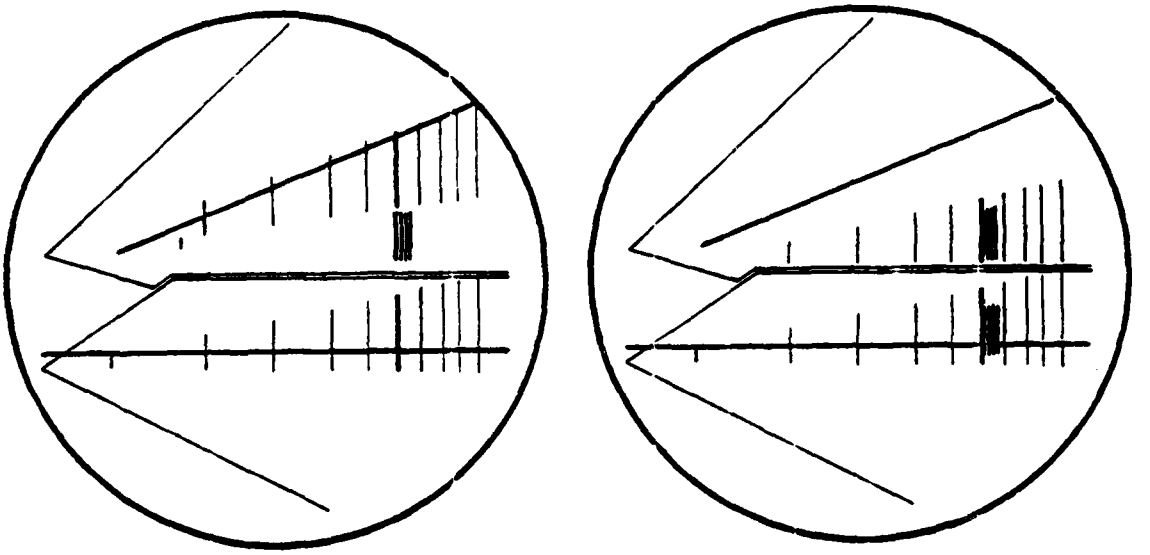
What would you have to do to make the target appear on the elevation display? Visualize the procedure. Draw the new picture.



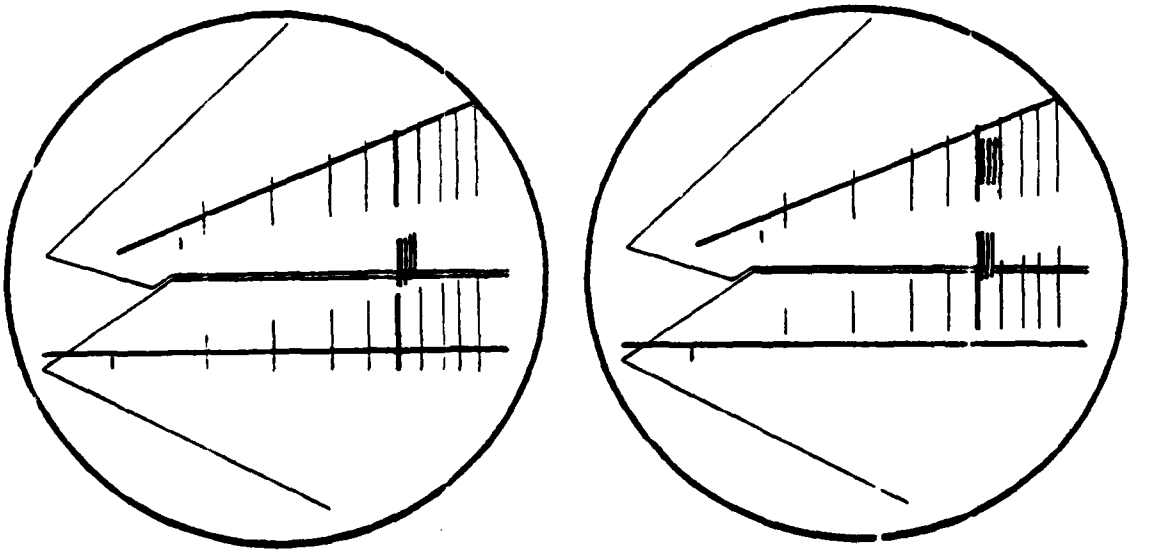
You surely said, "To get that target on elevation I'd servo right." Right!



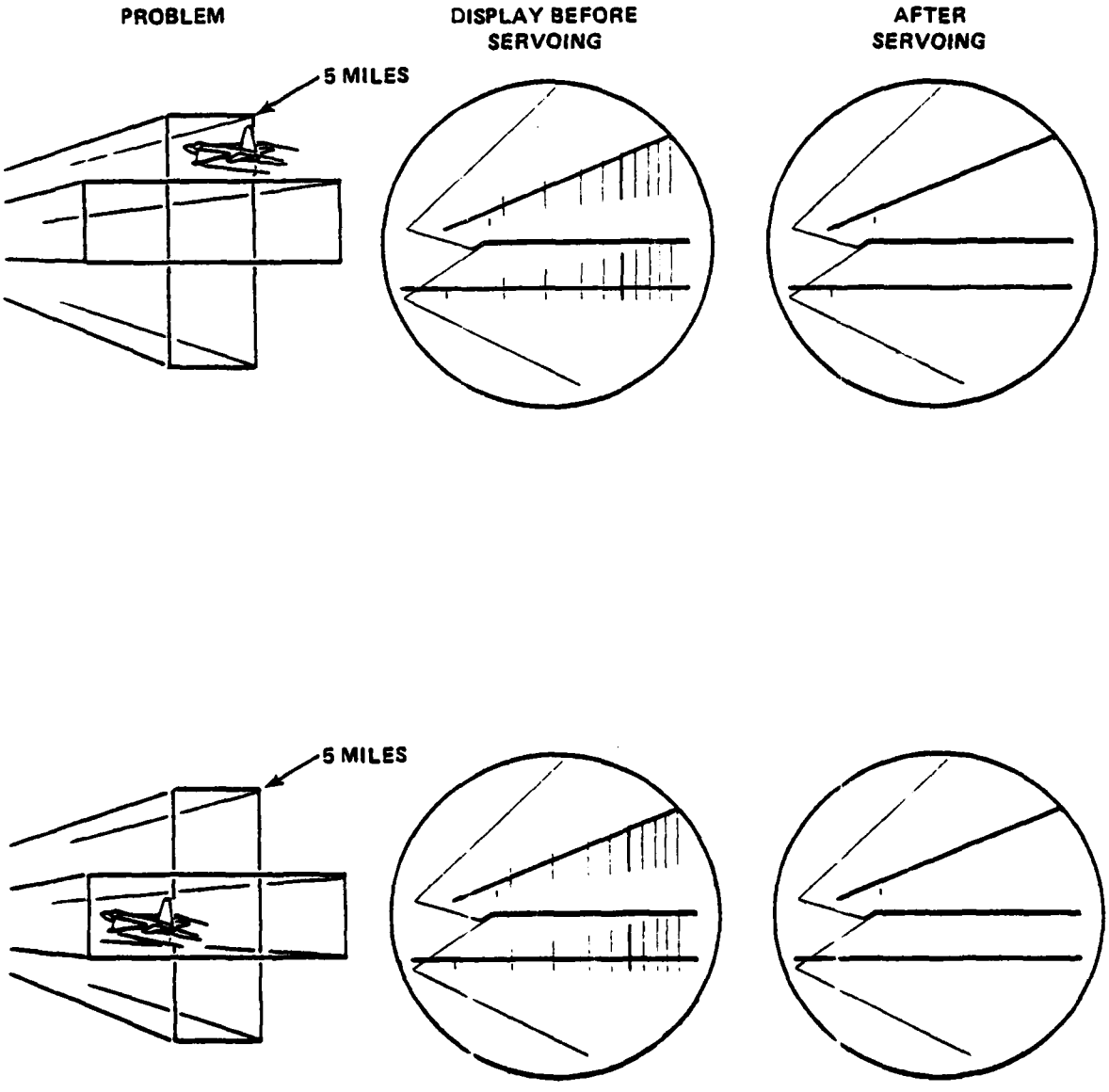
Can you make up a simple rule that always works to regain a lost target? Look again at these two cases.



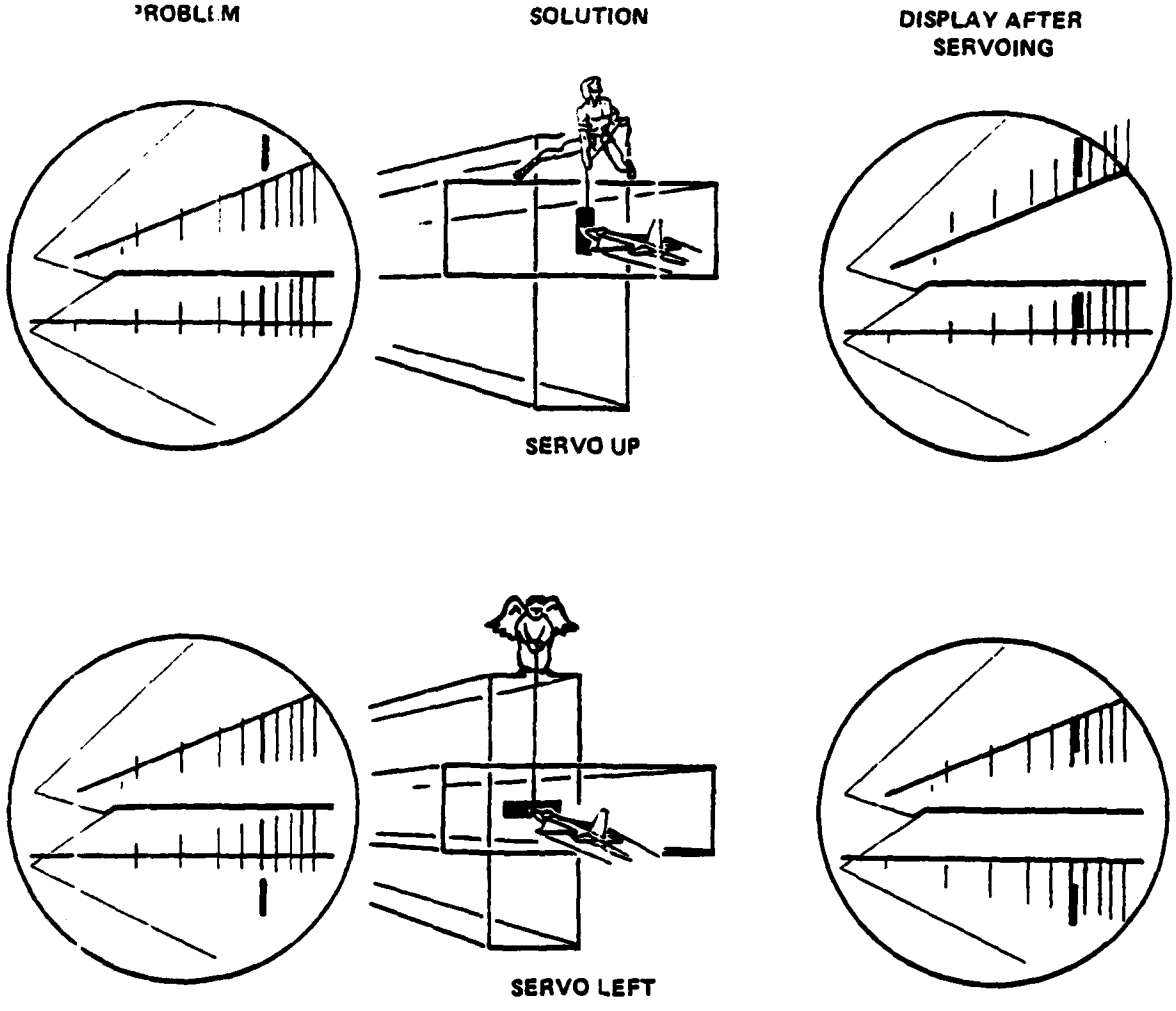
What did you do in each case that was the same?



The general rule about servoing to maintain radar contact is: Servo toward the target you have. You will notice that whenever the target separates from the hashmarks on one display, it begins to disappear on the other display. If you servo toward the target to move the hash marks so that they touch it, the target will reappear on the other display. Try out the rule of these problems.



Here are the answers.



CAUTION

When you are working in a live environment, several controllers may be using the PAR radar and there may be more than one aircraft on final. In this situation, DON'T servo without coordinating with the other controllers, especially if there is an aircraft closer to touchdown than your own. You could cause another controller to lose his or her target.

7.3 EMERGENCY WAVEOFFS

Emergency waveoff procedures must be used if you lose radar contact with your aircraft for five seconds. This can happen because of a radar failure, because of weather, or because of improper servoing. Only the latter, improper servoing, will happen in the GCA-CTS. The procedure used depends upon whether or not you have transmitted the clearance advisory. If clearance has been transmitted, give the pilot the option of continuing the approach. Say,

Radar contact lost (pause)
If runway not in sight execute missed approach (pause)
Climb and maintain three thousand (pause)
Turn right (pause)
Proceed direct point Bravo hold until advised by GCA (pause)
Over (pause)

If clearance has <u>not</u> been transmitted, do <u>not</u> give the pilot the option of continuing the approach. Say,

Radar contact lost (pause)
Execute missed approach (pause)
Climb and maintain three thousand (pause)
Turn right (pause)
Proceed direct point Bravo hold until advised by GCA (pause)
Over (pause)

These pauses are tricky – be sure to practice the phrases before trying to use them.

After this transmission, contact the pattern controller on ICS 5 and inform him of the missed approach in the usual way.

THE LAW

IDENTIFICATION STATUS.

Inform an aircraft when radar contact is lost. Phraseology: RADAR CONTACT LOST (alternative instructions, if required).

FINAL APPROACH ABNORMALITIES.

Instruct the aircraft if runway environment not in sight, execute a missed approach, if previously given; or climb to maintain a specific altitude and fly a specific course, whenever the completion of a safe approach is questionable...The conditions...do not apply after the aircraft passes decision height.

Example: Examples of REASON for issuing missed approach instructions: RADAR CONTACT LOST. TOO HIGH/ LOW FOR SAFE APPROACH. TOO FAR RIGHT/LEFT FOR SAFE APPROACH.

Radar contact is lost or a malfunctioning radar is suspected. Phraseology: (reason) IF RUNWAY/APPROACH LIGHTS/RUNWAY LIGHTS NOT IN SIGHT, EXECUTE MISSED APPROACH.

EMERGENCY DETERMINATIONS.

When you believe an emergency exists or is imminent, select and pursue a course of action which appears to be most appropriate under the circumstances and which most nearly conforms to the instructions in this manual. If you are in doubt that a given situation constitutes a potential emergency, handle it as though it were an emergency.

Note: Because of the infinite variety of possible situations, specific procedures cannot always be prescribed for every situation which might be considered an emergency. As a rule of thumb, an emergency includes any situation which places an aircraft in danger; i.e., uncertainty, alert, being lost, or in distress.

GRADING

RADAR CONTACT LOST

EMERGENCY WAVEOFF

	Partial Credit	Total Possible Points
1. If the target moves off the display or the display fails, issue waveoff*	50	
2. Issued within 5 seconds*	25	
3. Proper R/T for type of approach	25	
		100

*Safety error

7.1 NO-GYRO APPROACH

If the pilot's gyro compass (gyro) fails, he or she will be unable to turn to or maintain an assigned heading. No-gyro procedures have been developed to enable the aircraft to make a safe approach in this emergency situation. The first problem you face is one of detecting the no-gyro condition. The pattern controller may give you a no-gyro handoff ("Position 4 handoff...This will be a no-gyro PAR approach"). Or the gyro may fail on final, in which case it is up to you to notice it and to announce a no-gyro approach. The most common indication of gyro failure (the only one you'll see in the GCA-CTS) is that the pilot will fail to take a heading correction. If more than one-quarter mile elapses after you have given a turn and no heading correction is seen, give a heading advisory: "Heading...[digit]...[digit]...[digit]." If there is no change in the aircraft's track within one-half mile, you must announce the no-gyro approach. The procedure used depends upon where the gyro failure was detected.

If gyro failure is detected before the "do not acknowledge" advisory, the sequence is:

[Call sign] (pause)
This will be a no-gyro PAR approach (pause)
Over (pause)

.
.
.

Begin descent (pause)
Make half standard rate turns (pause)

If gyro failure is detected after the "begin descent" advisory, say:

This will be a no-gyro PAR approach (pause)
Make half standard rate turns (pause)

("PAR" is spelled out; don't say it as one word.)

You will have to start and stop all turns. This is the reason for the slower turn rate on final – it gives you better control of the turn. To turn the aircraft, use these transmissions:

Before "do not acknowledge":

[Call sign] (pause)
Turn [left/right] (pause)
Over (pause)

and

[Call sign] (pause)
Stop turn (pause)
Over (pause)

After "do not acknowledge" use:

Turn [left/right] (pause)

and

Stop turn (pause).

It is a good idea to actually time these heading corrections, especially when you are just learning. Before the "make half standard rate turns" transmission, the aircraft will turn at 3° per second. After this transmission, it will turn at 1 1/2° per second. When you decide to issue a course correction, figure the number of degrees of correction that is needed and the amount of time it will take to turn that far, then issue the turn and count the seconds. As an example, suppose you wish to give the aircraft a 5° correction. If you have already said "make half standard rate turns," it will take the pilot a little over three seconds to turn 5°. Allowing for pilot reaction time, a good strategy would be to count four seconds from the time you finish saying "turn [right/left] " then say "stop turn." Try for precision! Don't start S-turning, and don't forget to say "stop turn."

GRADING

NO-GYRO PROCEDURES

When you conduct a no-gyro approach, the system will check these points.

No-Gyro Composite

		Partial Credit	Total Possible Points
A.	Warn pilot		
	Give "heading XXX" if 1/4 mile elapses after a turn and less than a 2° change in course is observed	20	
B.	Prepare for no-gyro		
	1. Announce no-gyro approach	30	
	2. Announce no-gyro approach (prior to 3/4 mile from warning pilot) if course correction is not taken within 1/2 mile (given until 3/4 mile after warning before error reported)	10	
	3. Issue the announcement prior to 3/4 mile from the point at which warning was issued (given if announcement made after 3/4 mile)	10	
C.	Make half standard rate turns		
	1. Give advisory	10	
	2. Issued after begin descent, and no-gyro announcement	10	
	3. Transmitted only once	10	
			100

No-Gyro Heading Corrections

		Weighting Factor Applied to Percentage Error	Total Possible Points
A.	Turn must be in correct direction	.4	
B.	Stop turn must be issued	.4	
C.	If target enters zone 3 from zone 2, a heading correction must be given within 20 seconds	.2	
			100

LEVEL SEVEN

RADIO TERMINOLOGY SUMMARY

Event	PAR Controller Response	Purpose
Target exceeds one target width per mile below glidepath.	"Low altitude alert check your altitude immediately."	Warn the pilot that the aircraft is too low.
Target disappears from indicator, clearance has been transmitted.	"Radar contact lost...If runway not in sight execute missed approach...climb and maintain three thousand... turn right...proceed direct point Bravo hold until advised by GCA...over."	Inform the pilot that ground controlled approach cannot continue due to loss of radar contact.
Target disappears from indicator, clearance not transmitted.	"Radar contact lost... execute missed approach... climb and maintain three thousand...turn right... proceed direct point Bravo hold until advised by GCA... over."	
Symptoms of gyro failure: failure to take a turn within 1/4 mile.	"Heading...[digit]... [digit]...[digit]."	Remind pilot of assigned heading.
No change in track 1/2 mile after a turn is given.	"This will be a no-gyro PAR approach."	Announce no-gyro approach.
No-gyro approach has been announced, begin descent has been given.	"Make half standard rate turns."	The pilot to turn at 1 1/2° per second.
Heading correction is needed, no-gyro approach has been announced.	"Turn [right/left]."	Tells pilot to start a turn.
Heading correction is complete.	"Stop turn."	Stop the turn.

APPENDIX A

INIT NEW R/T

A.0 INTRODUCTION

The INIT NEW R/T key should only be used if a voice test reveals that the system is having difficulty recognizing a particular phrase. If this happens, you can cause the system to collect new samples of your speech for the phrase it does not recognize.

The voice reference pattern the system uses to recognize your phrase is created by "averaging" ten repeats of the phrase (or four repeats in some cases). The system always keeps the last ten (or four) repeats of each phrase collected during voice data collection. Using this key, you can replace up to half of these repeats and cause a new reference pattern to be created. For example, if you specify three repeats for a ten-repeat phrase, a new reference pattern will be formed using seven repeats collected previously plus the three collected at your request.

A.1 TIPS

- Follow the guidelines for good speech recognition which are printed on the inside front cover of your Student Guide while you are "teaching" GCA-CTS to recognize your voice and while you are using the recognition system.
- Say the phrase as you would in a control situation. It is helpful to visualize the situation and say the phrase as though you were talking to the pilot.
- Try practicing the phrase before you have the system collect the new patterns. Make sure you are not pausing in the middle of it!
- Say the phrase in slightly different but natural ways so the system has samples of all the ways you are likely to sound.

A.2 HOW TO USE THE KEY

You may depress INIT NEW R/T any time after you sign on. At the end of a problem the system will prompt you by typing:

Please enter the phrase number (or -1 to terminate):

Enter the phrase number from the list in Table A-1, then strike the carriage return key (marked "CR"). If there are no more phrases you wish to train, enter -1 followed by a carriage return.

If you have entered a phrase number, the system then asks,

Enter the number of repeats:

Enter a number from 1 to the maximum number shown in the table, and then strike the carriage return.

The system will now prompt you on the CRT. Repeat the phrases after the prompts appear.

Table A1. GCA-CTS Phrase List

PATTERN CONTROLLER DIALOG

MAXIMUM REPEATS	PHRASE NUMBER	PHRASE
2	75	POSITION FOUR ROGER
2	76	RADAR BUTTON ONE
2	77	RADAR BUTTON TWO
2	83	GIVE ME BUTTON ONE
2	84	GIVE ME BUTTON TWO
2	33	ON THE GO
5	26	MISSED APPROACH
2	1	1 MILE
2	2	1 AND 1/2 MILES
2	3	2 MILES
2	4	2 AND 1/2 MILES
2	5	3 MILES
2	6	3 AND 1/2 MILES
2	30	BUTTON ONE
2	32	BUTTON TWO
2	24	BUTTON ONE CLEAR
2	25	BUTTON TWO CLEAR

CALL SIGNS

MAXIMUM REPEATS	PHRASE NUMBER	PHRASE
2	85	ARMY EIGHT SEVEN SIX
2	86	MARINE SIX EIGHT SEVEN
2	87	NAVY THREE ONE ZERO
2	88	AIR FORCE THREE ZERO SEVEN
5	89	OVER

RADIO/WHEEL CHECK; APPROACHING GLIDEPATH SEQUENCE

MAXIMUM REPEATS	PHRASE NUMBER	PHRASE
2	78	THIS IS YOUR FINAL CONTROLLER HOW DO YOU HEAR ME?
2	97	HOW DO YOU HEAR ME NOW?
2	79	WHEELS SHOULD BE DOWN
5	81	APPROACHING GLIDEPATH
2	80	DO NOT ACKNOWLEDGE FURTHER TRANSMISSIONS
2	82	BEGIN DESCENT
5	89	OVER

Table A1. GCA-CTS Phrase List (Cont.)

RANGE CALLS

MAXIMUM REPEATS	PHRASE NUMBER	PHRASE
2	48	1 MILE FROM TOUCHDOWN
2	49	2 MILES FROM TOUCHDOWN
2	50	3 MILES FROM TOUCHDOWN
2	51	4 MILES FROM TOUCHDOWN
2	92	5 MILES FROM TOUCHDOWN
2	93	6 MILES FROM TOUCHDOWN
2	94	7 MILES FROM TOUCHDOWN
2	95	8 MILES FROM TOUCHDOWN

COURSE AND HEADING MESSAGES

MAXIMUM REPEATS	PHRASE NUMBER	PHRASE
5	62	ON COURSE
5	64	SLIGHTLY RIGHT OF COURSE
5	63	SLIGHTLY LEFT OF COURSE
5	55	RIGHT OF COURSE
5	53	LEFT OF COURSE
5	54	WELL RIGHT OF COURSE
5	52	WELL LEFT OF COURSE
5	65	CORRECTING
2	37	ON CENTERLINE
2	41	SLIGHTLY RIGHT OF CENTERLINE
2	39	SLIGHTLY LEFT OF CENTERLINE
2	40	RIGHT OF CENTERLINE
2	38	LEFT OF CENTERLINE
5	105	TURN RIGHT HEADING
5	107	TURN LEFT HEADING
5	106	HEADING
5	13	0
5	14	1
5	15	2
5	16	3
5	17	4
5	18	5
5	19	6
5	20	7
5	21	8
5	22	9

Table A1. GCA-CTS Phrase List (Cont.)

GLIDEPATH MESSAGES

MAXIMUM REPEATS	PHRASE NUMBER	PHRASE
5	66	ON GLIDEPATH
5	70	SLIGHTLY ABOVE GLIDEPATH
5	68	SLIGHTLY BELOW GLIDEPATH
5	69	ABOVE GLIDEPATH
5	67	BELOW GLIDEPATH
5	57	WELL ABOVE GLIDEPATH
5	56	WELL BELOW GLIDEPATH
5	72	COMING UP
5	74	COMING DOWN
5	73	GOING ABOVE GLIDEPATH
5	71	GOING BELOW GLIDEPATH
5	59	GOING FURTHER ABOVE GLIDEPATH
5	58	GOING FURTHER BELOW GLIDEPATH
2	61	AT DECISION HEIGHT

CLEARANCE

MAXIMUM REPEATS	PHRASE NUMBER	PHRASE
5	44	WIND
2	7	AT
5	13	0
5	14	1
5	15	2
5	16	3
5	17	4
5	18	5
5	19	6
5	20	7
5	21	8
5	22	9
2	45	CLEARED FOR LOW APPROACH
2	46	CLEARED FOR TOUCH AND GO
2	47	CLEARED TO LAND
2	8	TOWER CLEARANCE CANCELLED
2	9	TOWER CLEARANCE NOT RECEIVED

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GROUND CONTROLLED APPROACH CONTROLLER TRAINING SYSTEM (GCA-CTS)--ETC(U)
JUN 80 M HICKLIN N61339-77-C-0162
UNCLASSIFIED NAVTRAEQUIPC-77-C-0162-4 NL

Table A1. GCA-CTS Phrase List (Cont.)

APPROACH TERMINATION

MAXIMUM REPEATS	PHRASE NUMBER	PHRASE
2	61	AT DECISION HEIGHT
2	34	OVER LANDING THRESHOLD
2	37	ON CENTERLINE
2	41	SLIGHTLY RIGHT OF CENTERLINE
2	39	SLIGHTLY LEFT OF CENTERLINE
2	40	RIGHT OF CENTERLINE
2	38	LEFT OF CENTERLINE
2	23	CONTACT TOWER AFTER LANDING

NO-GYRO PHRASEOLOGY

MAXIMUM REPEATS	PHRASE NUMBER	PHRASE
2	90	THIS WILL BE A NO-GYRO PAR APPROACH
2	91	MAKE HALF STANDARD RATE TURNS
5	99	TURN RIGHT
5	100	STOP TURN
5	101	TURN LEFT

UNUSUAL SITUATIONS AND WAVEOFFS

MAXIMUM REPEATS	PHRASE NUMBER	PHRASE
5	98	CORRECTION
2	8	TOWER CLEARANCE CANCELLED
2	9	TOWER CLEARANCE NOT RECEIVED
2	42	TOO LOW FOR SAFE APPROACH
2	43	TOO HIGH FOR SAFE APPROACH
2	35	TOO FAR LEFT FOR SAFE APPROACH
2	36	TOO FAR RIGHT FOR SAFE APPROACH
2	27	IF RUNWAY NOT IN SIGHT
2	28	IF RUNWAY NOT IN SIGHT EXECUTE MISSED APPROACH
5	102	EXECUTE MISSED APPROACH
2	60	CLIMB AND MAINTAIN ONE THOUSAND FIVE HUNDRED
5	105	TURN RIGHT HEADING
5	103	RADAR CONTACT LOST
2	104	CLIMB AND MAINTAIN THREE THOUSAND
5	99	TURN RIGHT
2	31	PROCEED DIRECT POINT BRAVO HOLD UNTIL ADVISED BY GCA
2	96	LOW ALTITUDE ALERT CHECK YOUR ALTITUDE IMMEDIATELY

Table A1. GCA-CTS Phrase List (Cont.)

OTHER PHRASEOLOGY

MAXIMUM REPEATS	PHRASE NUMBER	PHRASE
5	89	OVER
5	98	CORRECTION